OPERATOR'S & MAINTENANCE MANUAL

MODELS 452 & 852
DUAL HI/LO FILTERS

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SAFETY FIRST

PROTECT YOURSELF. Follow these precautions:

- Don't touch the outputs of the instrument or any exposed test wiring carrying the output signals. This instrument can generate hazardous voltages and currents.
- Don't bypass the power cord's ground lead with two-wire extension cords or plug adaptors.
- Don't disconnect the green and yellow safety-earth-ground wire that connects the ground lug of the power receptacle to the chassis ground terminal (marked with ⏚ or ⚠).
- Don't hold your eyes extremely close to an rf output for a long time. The normally nonhazardous low-power rf energy generated by the instrument could possibly cause eye injury.
- Don't plug in the power cord until directed to by the installation instructions.
- Don't repair the instrument unless you are a qualified electronics technician and know how to work with hazardous voltages.
- Pay attention to the **WARNING** statements. They point out situations that can cause injury or death.
- Pay attention to the CAUTION statements. They point out situations that can cause equipment damage.

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

The Models 452 and 852 are versatile dual-channel filters consisting of two identical channels in a common cabinet. Each filter channel has separate input/output terminals, offers high pass and low pass functions, 0 dB and 20 dB gain, Butterworth and Linear Phase responses and 3-digit resolution for cutoff frequency selection.

Individual channels may be readily interconnected for series or parallel operation, resulting in bandpass (or doubled rolloff) and band reject functions respectively.

Each filter channel provides switch selectable Flat Amplitude (Butterworth) response and Flat Delay (Linear Phase) response.

The Butterworth filter has maximally-flat amplitude response suitable for frequency-domain applications. Its cutoff frequency (fc) is defined as the frequency at which the amplitude response is down 3 dB.

The Linear Phase filter approximates a constant time delay for frequencies below its cutoff frequency. This filter is suitable for time-domain applications because of its inherent ability to pass transient waveforms with a very small amount of distortion and overshoot.

Models 452 and 852 are electrically and mechanically similar, covering the cutoff frequency range of 0.1 Hz to 111 KHz. Rolloff of the Model 452 is 24 dB/octave/channel, Model 852 is 48 dB/octave/channel. Factory-installed Option -01 extends cutoff frequency range and resolution on both models to 0.01 Hz.

Frequency-determining passive elements of the filters consist of stable precision metal film resistors and close tolerance polycarbonate or mica film capacitors. The active elements are FET-input IC operational amplifiers which provide highly stable gain, and very low noise and distortion. This combination of active and passive elements produces a filter having high cutoff frequency accuracy and resettability, and excellent temperature and long term stability. Another result of precise control of frequency-determining elements is close amplitude and phase match between channels.

1-2. DESCRIPTION

ELECTRICAL. Models 452 and 852 operate from either 115 or 230 volts ac, 50-500 Hz, and consume less than 5 watts of power. A rear-panel slide switch selects the nominal line voltage. The case of the instrument is grounded through the power cord, but signal ground can be isolated from power ground (through a 0.01 uf capacitor) via a rear-panel slide switch.

Cutoff frequency of each channel is selected via three 11-position (0-10) switches and a 4-position multiplier switch. The two pilot lights also serve as cutoff frequency decimal point indicators. Passband Gain of 0 dB or 20 dB may be selected for each channel. High Pass or Low Pass mode is individually selectable for each channel, as well as Flat Amplitude or Flat Delay response.

MECHANICAL. The instrument cabinet is 3.5 inches high by 17 inches wide (19 inches wide including rack mounts). It is 13 inches deep and weighs 10 pounds (Model 452) or 12 pounds (Model 852).

The power switch, operating controls, and input and output terminals are located on the front panel. The rear panel contains duplicate (parallel) input and output terminals for each channel, power connector, the fuse holder, the 115/230 Vac line selector switch, and a switch to disconnect signal ground from the power ground.

In its standard configuration the instrument is supplied in a cabinet suitable for table-top use, with feet and tiltstand. A rack-mount configuration is also available (See Options).

1-3. OPTIONS

The following options are available for both models:

Option -01:	Extends low frequency range and resolution to 0.01 Hz.
Option -02:	Provides 600-ohm nominal output impedance instead of 50 ohms.
Option -03:	The instrument is shipped from the factory in a rack-mount configuration without feet and tiltstand.
Option -04:	A field-installable conversion kit, supplied in addition to the standard configuration. It enables the user to convert the instrument to rack-mount configuration.

1-4. SPECIFICATIONS, MODEL 452 & 452-01

FUNCTIONS

Each Channel:	Low Pass (DC Coupled) with 24 dB/oct rolloff High Pass with 24 dB/oct rolloff
Two Channels connected in series:	
Identical cutoff frequencies	Low Pass with 48 dB/oct rolloff
Identical cutoff frequencies	High Pass with 48 dB/oct rolloff
One channel High Pass, one channel Low Pass	Band Pass with 24 dB/oct rolloffs
Two channels connected in parallel:	Band Reject: Broadband with 24 dB/oct rolloff, or Sharp Notch Response

CUTOFF FREQUENCY RANGE & RESOLUTION

Frequency Settings: Three 11-position switches (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10) and a four-position (x10, x100, x1K, x10K) multiplier switch. Option -01 adds a fifth position (x1) to the multiplier switch.

Frequency Range:
With Option -01

Multiplier	Frequency (Hz)	Resolution (Hz)
x1	0.01-11.1	0.01
x10	0.1-111	0.1
x100	1-1.11K	1
x1K	10-11.1K	10
x10K	100-111K	100

NOTE

Specifications apply for cutoff frequency dial settings from 0.10 to 10.1010.

FLAT AMPLITUDE (BUTTERWORTH) RESPONSE

Passband Gain:

Low Pass: 0 dB/20 dB, ± 0.25 dB.
High Pass: 0 dB/20 dB, ± 0.25 dB, (±0.5 dB in x 10K Multiplier position); - 3dB at approximately 2 MHz.

Band Pass: Depends on separation of cutoff frequencies. If separation is more than two octaves, the Low Pass & High Pass specifications apply. If Low Pass & High Pass cutoffs are identical, an insertion loss of approx. 6 dB is produced; the 3 dB bandwidth extends from 0.8 f_c to 1.25 f_c and is equal to 0.45 f_c.
Band Reject & Sharp Notch: An insertion loss of approximately 6 dB is produced.

FLAT AMPLITUDE (BUTTERWORTH) RESPONSE - continued

Cutoff Frequency Accuracy:	± 2%
Attenuation at Cutoff:	3 dB
Stopband Attenuation Rate (Rolloff):	24 dB/octave, nominal
Maximum Stopband Attenuation:	80 dB minimum ($f_{in} \leq 400$ kHz, 1K and 10K multiplier ranges) 70 dB minimum ($f_{in} \leq 300$ kHz, 100 and 10 multiplier ranges).
Stability of Cutoff Frequency (Typical):	± 200 ppm/°C
Phase Match between Channels (Typical):	1° or 1%, whichever is greater

FLAT DELAY RESPONSE

Low Pass Delay (Typical):	$\frac{1}{2 f_c}$ seconds
Attenuation at Cutoff:	Approx. 9 dB
Stability of Delay (Typical):	± 200 ppm/°C
Phase Match between Channels (Typical):	1° or 1%, whichever is greater

INPUT CHARACTERISTICS

Circuit:	Single-ended, diode-protected
Impedance:	1 Megohm shunted by 50 pF
Full-scale Signal at 0 dB Gain:	± 10 Volts (7.1 V rms) DC to 300 KHz, decreasing to ± 4 Volts (2.8 V rms) at 1 MHz (Divide these by 10 at 20 dB Gain).
Absolute max. Input:	± 100 Volts
Max. DC component:	High Pass: ± 100 Volts, 0 dB gain, ± 10 Volts, 20 dB gain

OUTPUT CHARACTERISTICS

Circuit:	Single-ended, short-circuit protected, may be d-c isolated from power ground by rear panel switch
Impedance:	50 ohms, nominal
Full-Scale Signal:	± 10 Volts (7.1 V rms) DC to 300 KHz, decreasing to ± 4 Volts (2.8 V rms) at 1 MHz ($R_L \geq 5K$), ± 15 mA max. current
Broadband Noise at either Gain Setting:	100 microvolts rms max. for 100 KHz detector bandwidth
Harmonic Components: Input f = 1 KHz	90 dB below full-scale signal
A-C Line-related Spurious Components:	110 dB below full-scale signal *
DC Offset at 25° C:	Within ±2.5 millivolts at any f_c setting
Drift vs. Temperature:	100 microvolts/°C typ, 500 microvolts/°C max.
Drift vs. Time (Typical):	100 microvolts/week

TYPICAL EQUIVALENT INPUT NOISE SPECTRAL DENSITY

At f = 10 Hz	100 nanovolts/$\sqrt{Hz}$
f = 100 Hz	60 nanovolts/$\sqrt{Hz}$
f ≧ 1 KHz	20 nanovolts/$\sqrt{Hz}$

GENERAL

Power Requirements:	115/230 Vac ± 10%, 50-500 Hz, 5 watts
Operating Temperature:	0°C to + 50°C
Storage Temperature:	-20°C to + 70°C
Connectors:	BNC's on front & rear panel
Floating Operation:	Slide switch on rear panel to disconnect circuit ground from power ground.

* Derate specification by 6 dB for Model 452-01 when operating in its optional range (x1)

1-4. SPECIFICATIONS, MODEL 452 & 452-01 - continued

GENERAL - continued

Size:	3-1/2" H x 17" W x 13" D (8.9 cm x 43.2 cm x 33 cm)
Weight:	10 lbs. (4.5 Kg) Net, 14 lbs. (6.5 Kg) Shipping
Configuration:	Bench-Top, convertible to rack-mount
Accessories supplied:	2 Instruction Manuals

1-5. SPECIFICATIONS, MODEL 852 & 852-01

FUNCTIONS

Each Channel:	Low Pass (DC Coupled) with 48 dB/oct rolloff High Pass with 48 dB/oct rolloff
Two Channels connected in series:	
(Identical cutoff frequencies)	Low Pass with 96 dB/oct rolloff
(Identical cutoff frequencies)	High Pass with 96 dB/oct rolloff
(One channel High Pass, one channel Low Pass)	Band Pass with 48 dB/oct rolloff
Two channels connected in parallel:	Band Reject with 48 dB/oct rolloff

CUTOFF FREQUENCY RANGE & RESOLUTION

Frequency Settings: Three 11-position switches (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10) and a four-position (x10, x100, x1K, x10K) multiplier switch. Option -01 adds a fifth posotion (x1) to the multiplier switch.

Frequency Range:
With Option -01

Multiplier	Frequency (Hz)	Resolution (Hz)
x1	0.01-11.1	0.01
x10	0.1-111	0.1
x100	1-1.11K	1
x1K	10-11.1K	10
x10K	100-111K	100

NOTE

Specifications apply for cutoff frequency dial settings from 0.10 to 10.1010.

FLAT AMPLITUDE (BUTTERWORTH) RESPONSE

Passband Gain:	Low Pass: 0 dB/20 dB, ± 0.5 dB. High Pass: 0 dB/20 dB, ± 0.5 dB, (± 1 dB in x 10K Multiplier position); - 3 dB at approximately 1 MHz. Band Pass: Depends on separation of cutoff frequencies. If separation is more than two octaves, the Low Pass & High Pass specifications apply. If Low Pass & High Pass cutoffs are identical, an insertion loss of approx. 6 dB is produced; the 3 dB bandwidth extends from 0.9 f_c to 1.12 f_c and is equal to 0.22 f_c. Band Reject: An insertion loss of approximately 6 dB is produced.
Cutoff Frequency Accuracy:	± 2%
Attenuation at Cutoff:	3 dB
Stopband Attenuation Rate (Rolloff):	48 dB/octave, nominal
Maximum Stopband Attenuation:	80 dB minimum ($f_{in} \leq$ 400 kHz, 1K and 10K multiplier range 70 dB minimum ($f_{in} \leq$ 300 kHz, 100 and 10 multiplier range
Stability of Cutoff Frequency (Typical):	± 200 ppm/°C
Phase Match between Channels (Typical):	2° or 2%, whichever is greater

FLAT DELAY RESPONSE

Low Pass Delay (Typical):	$\frac{1}{f_c}$ seconds
Attenuation at Cutoff:	Approx. 17 dB
Stability of Delay (Typical):	± 200 ppm/°C
Phase Match between Channels (Typical):	2° or 2%, whichever is greater

INPUT CHARACTERISTICS

Circuit:	Single-ended, diode-protected
Impedance:	1 Megohm shunted by 50 pF in 0 dB Gain, shunted by 75 pF in 20 dB Gain

INPUT CHARACTERISTICS - continued

Full-Scale Signal at 0 dB Gain:	± 10 Volts (7.1 V rms) DC to 300 KHz, decreasing to ± 4 Volts (2.8 V rms) at 1 MHz (Divide these by 10 at 20 dB Gain).
Absolute max. Input:	± 100 Volts
Max. DC component:	High Pass: ± 100 Volts, 0 dB gain, ± 10 Volts, 20 dB gain

OUTPUT CHARACTERISTICS

Circuit:	Single-ended, short-circuit protected, may be d-c isolated from power ground by rear panel switch
Impedance:	50 ohms, nominal
Full-Scale Signal:	± 10 Volts (7.1 V rms) DC to 300 KHz, decreasing to ± 4 Volts (2.8 V rms) at 1 MHz ($R_L \geq 5$ K), ± 15 mA max. current
Broadband Noise at either Gain Setting:	200 microvolts rms max. for 100 KHz detector bandwidth
Harmonic Components: Input f = 1 KHz	80 dB below full-scale signal
A-C Line-related Spurious Components:	100 dB below full-scale signal *
DC Offset at 25°C:	Within ± 2.5 millivolts at any f_c setting
Drift vs. Temperature:	300 microvolts/°C typ, 1.5 millivolts/°C max.
Drift vs. Time (Typical):	500 microvolts/week

TYPICAL EQUIVALENT INPUT NOISE SPECTRAL DENSITY

At f = 10 Hz	250 nanovolts/ $\sqrt{Hz}$
f = 100 Hz	100 nanovolts/ $\sqrt{Hz}$
f ≥ 1 KHz	40 nanovolts/ $\sqrt{Hz}$

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* Derate specification by 6 dB for Model 852-01 when operating in its optional range (x1)

GENERAL

Power Requirements:	115/230 VAC ± 10%, 50-500 Hz, 5 watts
Operating Temperature:	0° C to + 50°C
Storage Temperature:	-20°C to + 70°C
Connectors:	BNC's on front & rear panel
Floating Operation:	Slide switch on rear panel to disconnect circuit ground from power ground.
Size:	3 1/2" H x 17" W x 13" D (8.9 cm x 43.2 cm x 33 cm)
Weight:	12 lbs. (5.5 Kg) Net, 15 lbs. (7 Kg) Shipping
Configuration:	Bench-Top, convertible to rack-mount
Accessories supplied:	1 Instruction Manual

SECTION II

OPERATION

2-1. INTRODUCTION

The instrument is electrically operational as shipped from the factory. The following paragraphs describe inspection, power requirements, interconnection, and operation.

2-2. INSPECTION

This instrument was carefully inspected and tested prior to shipment. It was operated for a number of hours to reduce the probability of early failure. After unpacking the unit, inspect it carefully for shipping damage. Check especially for broken controls and connectors, and dented or scratched cabinet parts. Should the instrument show any signs of damage, file a claim with the carrier immediately. Preserve the carton and packing materials; they will be required by the carrier.

It is recommended that conformance to specifications be verified upon receipt. In case of discrepancies, refer to the warranty at the beginning of this manual.

2-3. INSTALLATION AND POWER REQUIREMENTS

Models 452 and 852 are designed for table-top operation or installation in a standard 19-inch RETMA rack. Ambient temperature within the rack must not exceed +50°C while the instrument is operating. Other paragraphs in this section describe connections and switch settings which should be made before the unit is installed.

Installation

To convert the instrument for mounting into a standard 19 inch wide rack, the following procedure should be followed. (Refer to Figure 2-0)

1 Unplug instrument from AC power source

2 Stand instrument on one side

3 Align rack mount bracket with raised edge of instrument as shown.

4 Holes on rack mount bracket should correspond to pem nut holes just underneath black trim strip. Use a pointed object to pierce the black trim strip at the pem nut holes.

5 Use lock washers and metal screws provided to secure rack mount bracket.

6. Repeat for other side bracket.

CAUTION: Rack mount brackets are to prevent the instrument from sliding when mounted in a rack. They are not intended to support the weight of the instrument and should never be used for lifting or carrying

Instrument is now ready for rack installation.

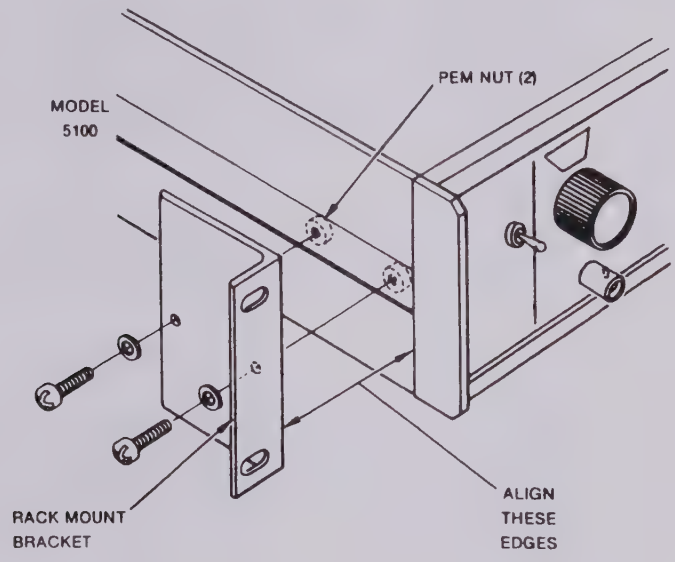

Figure 2-0. Installing Rack Mount Bracket

CAUTION

Always ensure that the 115/230 volt switch is set for the nominal line voltage and that a fuse of the proper rating is installed in the instrument. If the switch is set incorrectly or a fuse of the wrong rating is used, the instrument may be damaged or fail to operate.

Power

The instrument will operate from either 115 or 230 volts ac, 50-500 Hz. Converstion for line voltage is performed with a slide switch mounted on the rear panel (see Figure 2-1). The unit is shipped with the switch set for 115 volts. To change the setting, insert a small-blade screwdriver in the switch slot and move switch to expose 115 for 115 Vac operation, or 230 for 230 Vac operation.

The instrument is shipped with a 1/4-amp slow-blow fuse for 115-volt or 230-volt operation.

WARNING

In keeping with standard safety practice, the case of the instrument is grounded through the power cord. If the instrument must be connected to a two-wire receptacle, use a parallel-ground adapter and connect the short lead to ground.

2-4. CONTROLS AND INDICATORS

Controls and indicators are shown in Figure 2-1 and described in Table 2-1. The descriptions in Table 2-1 and the following paragraphs are not intended to be complete operating instructions, but only general information applying to all modes of operation. Paragraphs 2-5, through 2-10 describe filter settings, interconnection, and typical operating procedures.

Table 2-1. Controls and Indicators

NUMBER	DESCRIPTION
1	On Switch: The switch is moved to the on position to supply power to the instrument
-	Controls and Indicators numbered 2 through 11 pertain to Channel 1:
2	First significant digit of Cutoff Frequency setting, 0 - 10 positions, continuous rotation
3	A light-emitting diode (LED) indicates that power is on and also serves as a decimal point indicator for the Cutoff Frequency setting

Table 2-1. Controls and Indicators (Continued)

NUMBER	DESCRIPTION
4	Second significant digit of Cutoff Frequency setting, 0 - 10 positions, continuous rotation
5	Third significant digit of Cutoff Frequency setting, 0 - 10 positions, continuous rotation
6	Decimal Multiplier of Cutoff Frequency setting, 4 or 5 positions, depending on option
7	Low Pass (In) or High Pass (Out) selector switch
8	Output BNC Connector
9	Flat Delay (In) or Flat Amplitude (Out) selector switch
10	20 dB Gain (In) or 0 dB Gain (Out) selector switch
11	Input BNC Connector
-	Channel 2 Controls and Indicators are identical to those of Channel 1
12	Channel 2 Output BNC Connector
13	Channel 2 Input BNC Connector
14	Fuseholder for 1/4 Amp slow-blow fuse for either 115 V or 230 V operation
15	115/230 V line voltage selector switch
16	Two position switch: connects signal ground to power (and chassis) ground, or floats signal ground
17	Channel 1 Output BNC Connector
18	Channel 1 Input BNC Connector
19	3-wire power cord

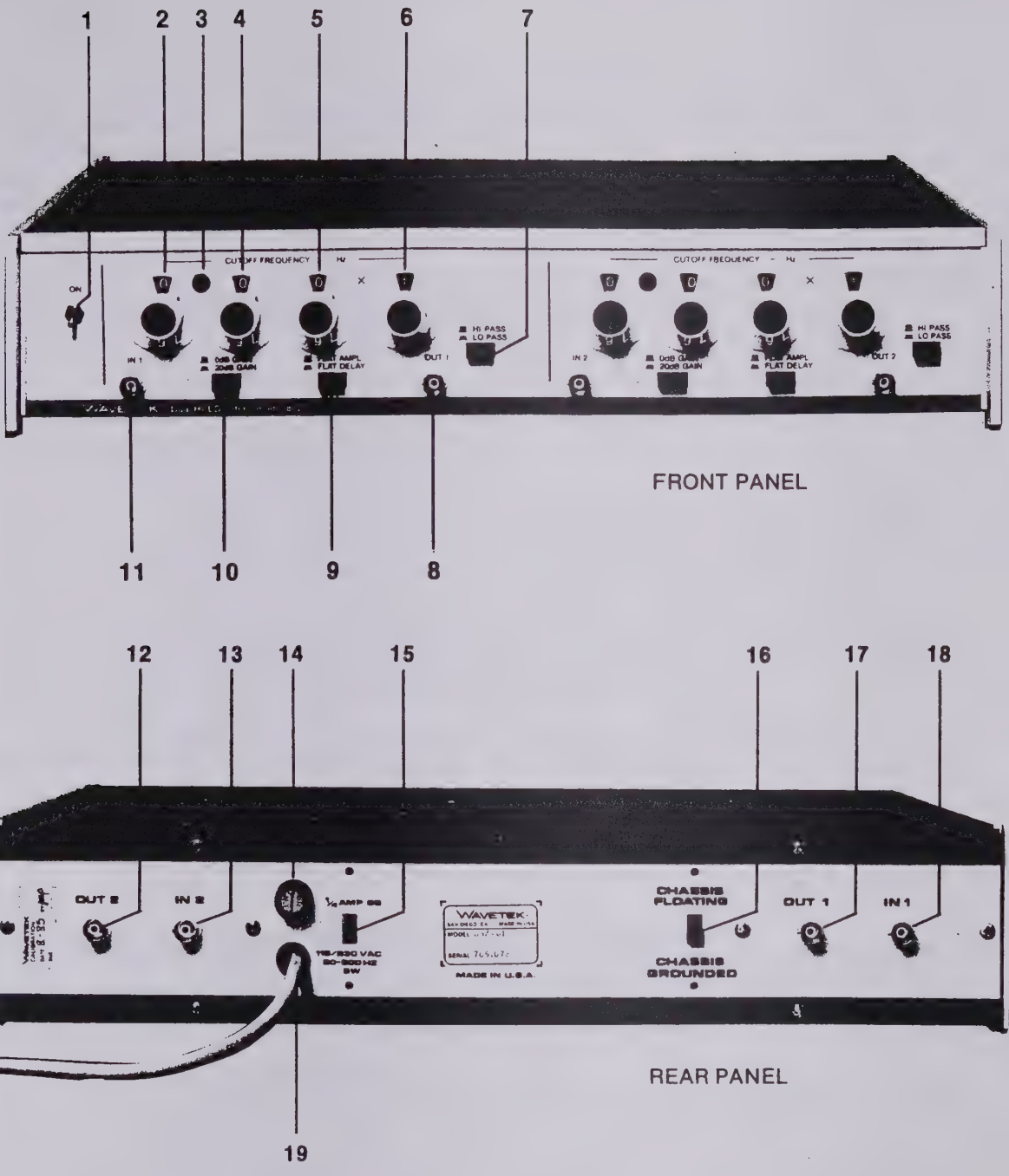

Figure 2-1. Controls and Indicators

2-5. INPUT SIGNAL

The maximum input signal amplitude (at 0 dB Gain) is specified as ±10 Volts (7.1 V rms) up to a frequency of 300 KHz. This is the signal amplitude which can be handled linearly by the instrument. Above 300 KHz the input signal handling capability is reduced as shown in Fig. 2-2. The reduction is due to Slew-Rate* limitations of the Operational Amplifiers employed in the instrument.

When 20 dB Gain is employed, the maximum input signal amplitude is ±1.0 Volt (0.71 V rms) up to 300 KHz.

CAUTION

Input signals in excess of ±100 V in either Gain setting may damage the instrument.

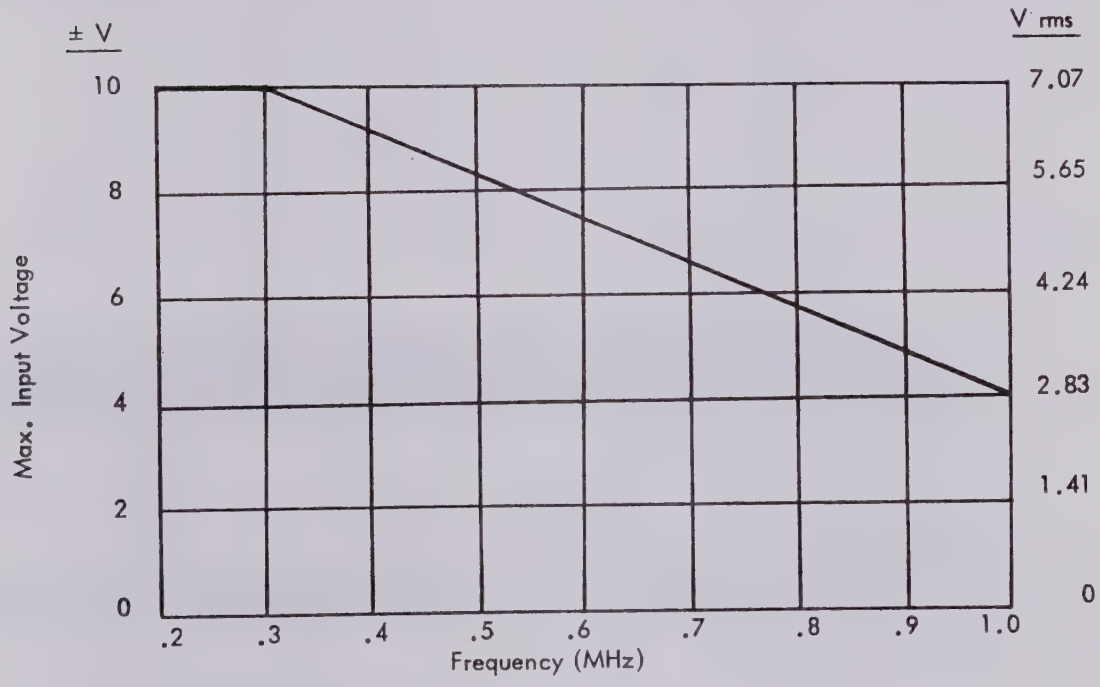

Fig. 2-2 Full-Scale Input Signal vs. Frequency

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* The term "Slew-Rate" refers to the ability of an Operational Amplifier to follow fast changes in input signal and it is usually expressed in volts/usec.

2-6. TYPICAL OPERATING PROCEDURES

a. Low-Pass or High-Pass Filter

The operating mode of each channel of the instrument is selected with the HI PASS/LO PASS switch. The position of this switch determines whether the channel is operating as a Low Pass (IN) or High Pass (OUT) filter.

In the Low Pass mode of operation the passband of the filter extends from DC to the cutoff frequency which is defined by the settings of the three CUTOFF FREQUENCY dials and the MULTIPLIER. In the High Pass mode of operation the passband extends from the cutoff frequency setting to the upper 3-dB point of the instrument (approximately 2 MHz for Model 452 and 1 MHz for Model 852).

b. Response Selection

The desired type of response for each channel is selected with the FLAT AMPL/ FLAT DELAY switch. The position of this switch determines whether the response of the channel is a Butterworth response (OUT) or Linear Phase response (IN).

The Butterworth characteristic provides a maximally flat amplitude response which is 3 dB down at the cutoff frequency. Beyond the cutoff frequency the amplitude response rolls off at a rate of 24 dB/octave (80 dB/decade) for the Model 452 and 48 dB/octave (160 dB/decade) for the Model 852.

The Low-Pass or High-Pass Butterworth response for either model may be determined by scaling the normalized plots given in Figures 2-3, 2-4, 2-5 and 2-6. To determine the frequency response for a particular Cutoff Frequency setting, the normalized scale on these plots should be multiplied by the cutoff frequency. For example, if the cutoff frequency is set to 500 Hz Low-Pass, then "1" on the normalized scale represents 500 Hz, "2" represents 1000 Hz and ".5" represents 250 Hz.

The Flat Delay characteristic provides a response which is useful for filtering squarewave or pulsed waveforms with minimum overshoot and ringing. While this response is available in either Low-Pass or High-Pass modes of operation, its primary usefulness is in Low-Pass mode.

Normalized Delay characteristics are given in Figures 2-7, 2-8, 2-9 and 2-10. For comparison, these figures include Phase and Delay characteristics for the Butterworth response.

The procedure for determining the Phase or Delay response for a particular Cutoff Frequency from the normalized plots is the same as outlined for the amplitude response. The actual Delay in seconds is equal to the value obtained from the plot divided by the value of cutoff frequency.

c. Gain Selection

The passband gain of each channel is selected with the 0 dB GAIN/20 dB GAIN Switch. The position of this switch determines whether the channel is operating with 0 dB Gain (OUT), or 20 dB Gain (IN).

The 20 dB Gain position is useful when filtering low-level signals. Since output noise of the filter is independent of the gain position, a 20 dB effective improvement in dynamic range is achieved.

d. Band-Pass Filter

The two channels of the instrument, one in High-Pass and the other in Low-Pass mode, may be cascaded as shown in Fig. 2-11 to provide Band-Pass operation. Flat Amplitude (Butterworth) response should be utilized in both channels.

When channels are cascaded for Band-Pass operation, the input signal should be connected to the High-Pass channel (IN 1), and the output of this channel (OUT 1) should be connected to the input of the Low-Pass channel (IN 2). The output signal is available at OUT 2.

The passband in this configuration extends from the High-Pass Cutoff Frequency to the Low-Pass Cutoff Frequency setting. Maximum passband gain of 40 dB is available. If only 20 dB gain is desired, channel 1 should be set to 20 dB gain and channel 2 should be set to 0 dB gain.

CAUTION

Reversing the gain settings will increase the output noise of this configuration, because channel 2 will amplify the output noise of channel 1.

The overall response of this configuration may be determined by combining the normalized plots given in Figures 2-3 through 2-6.

The narrowest Band-Pass is obtained by setting High-Pass and Low-Pass Cutoff Frequencies to the same value f_o. In this case an insertion loss of approximately 6 dB is produced at f_o. For the Model 452, the 3-dB bandwidth extends from 0.8 f_o to 1.25 f_o and is equal to 0.45 f_o. This corresponds to a Q of 2.2. For the Model 852, the 3-dB bandwidth extends from 0.9 f_o to 1.12 f_o and is equal to 0.22 f_o. This corresponds to a Q of 4.5. In this mode of operation, both instruments operate as constant - Q, or constant % - Bandwidth filters.

e. Band-Reject Filter

The two channels of the instrument, one in High-Pass and the other in Low-Pass mode, may be connected in parallel, as shown in Fig. 2-11 to provide Band-Reject operation. Flat Amplitude response should be utilized in both channels.

The input signal should be connected to both inputs (IN 1 and IN 2). The outputs (OUT 1 and OUT 2) should be summed through 1 K, 1% resistors. The output signal is available at the common point of these resistors. This connection produces a passband insertion loss of 6 dB.

CAUTION

Both channels must be set to the same gain setting. If they are both set to 0 dB gain, the output will be 6 dB below the input level in the passband. If they are both set to 20 dB gain, the output will be 14 dB above the input level in the passband.

The rejection band in this configuration extends from the Low-Pass Cutoff Frequency to the High-Pass Cutoff Frequency. Again, the overall response may be determined by combining the normalized plots given in Figures 2-3 through 2-6.

f. Sharp-Notch Filter (Model 452 only)

The Sharp-Notch response shown in Fig. 2-12 is a special case of Band-Reject operation of Model 452. Input signal, channel connections, etc. should be made as described under Band-Reject filtering.

To obtain a notch (or null) at a desired frequency f_o, the High-Pass Cutoff Frequency is set to 1.75 f_o and the Low-Pass Cutoff Frequency is set to 0.57 f_o. For optimum rejection the High-Pass and Low-Pass settings should be alternatively adjusted, starting with the least significant digits.

CAUTION

While the maximum rejection obtainable in this mode of operation approaches the noise floor of the instrument, the maximum measurable rejection may be limited by the harmonic content of the input sinewave. In this mode of operation, it is thus possible to use the instrument for distortion analysis.

g. Low Pass or High Pass Filter with Doubled Rolloff

The two channels of the instrument may be cascaded as shown in Fig. 2-11. The Cutoff Frequencies of both channels are set to the same value and both channels are set to either High Pass, or Low Pass. Flat Amplitude response is utilized in both channels. Signal and channel connections are made as described under Band-Pass Filter and gain settings should also be made in accordance with the instructions given under Band-Pass Filter.

The overall response of this configuration may be determined by combining the normalized plots given in Figures 2-3 through 2-6. The Response at the Cutoff Frequency will now be 6 dB down and Rolloff will be 48 dB/octave for Model 452 and 96 dB/octave for Model 852.

2-7. OUTPUT SIGNAL

Full-scale output signal is specified as ± 10 Volts and ± 15 mA , max. Above 300 KHz, the output signal will follow the reduction in input signal shown in Fig. 2-2, provided the current required by the load connected to the instrument does not exceed the maximum value of ± 15 mA. Heavy capacitive loads can easily exceed this current at high frequencies. For example, 25 feet of RG-58 cable is equivalent to a capacitance of 750 pf, which requires ± 15 mA current at 300 KHz.

2-8. CUTOFF FREQUENCY OVERRANGE

The unmarked position between 0 and 10 on the Cutoff Frequency dials is an active position corresponding to the digit 11. If all Cutoff Frequency dials are set to this position a maximum setting of 122.1 (110 + 11 + 1.1) is available.

This position provides a 10% overrange relative to the specified maximum setting of 111.

2-9. MINIMUM CUTOFF FREQUENCY SETTING

The minimum valid setting of the Cutoff Frequency dials is 0.01. The setting 0.00 is not valid.

2-10 CUTOFF FREQUENCY RESOLUTION

The Cutoff Frequency dials should always be set for maximum resolution. For example, a cutoff frequency of 500 Hz may be set as 5.00x100, 0.50x1K, or 0.05x10K. Of the above choices, 5.00x100 is the proper setting.

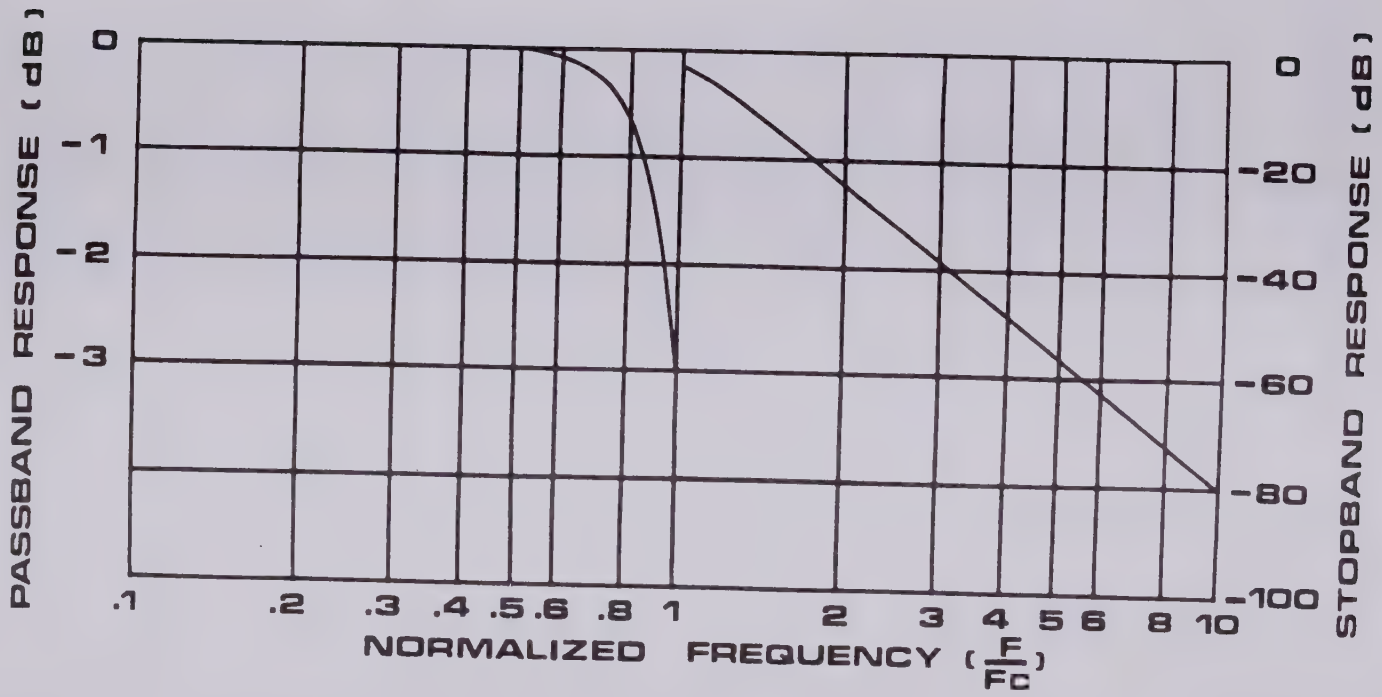


Fig. 2-3 452 Flat Ampl. Response - Lo Pass

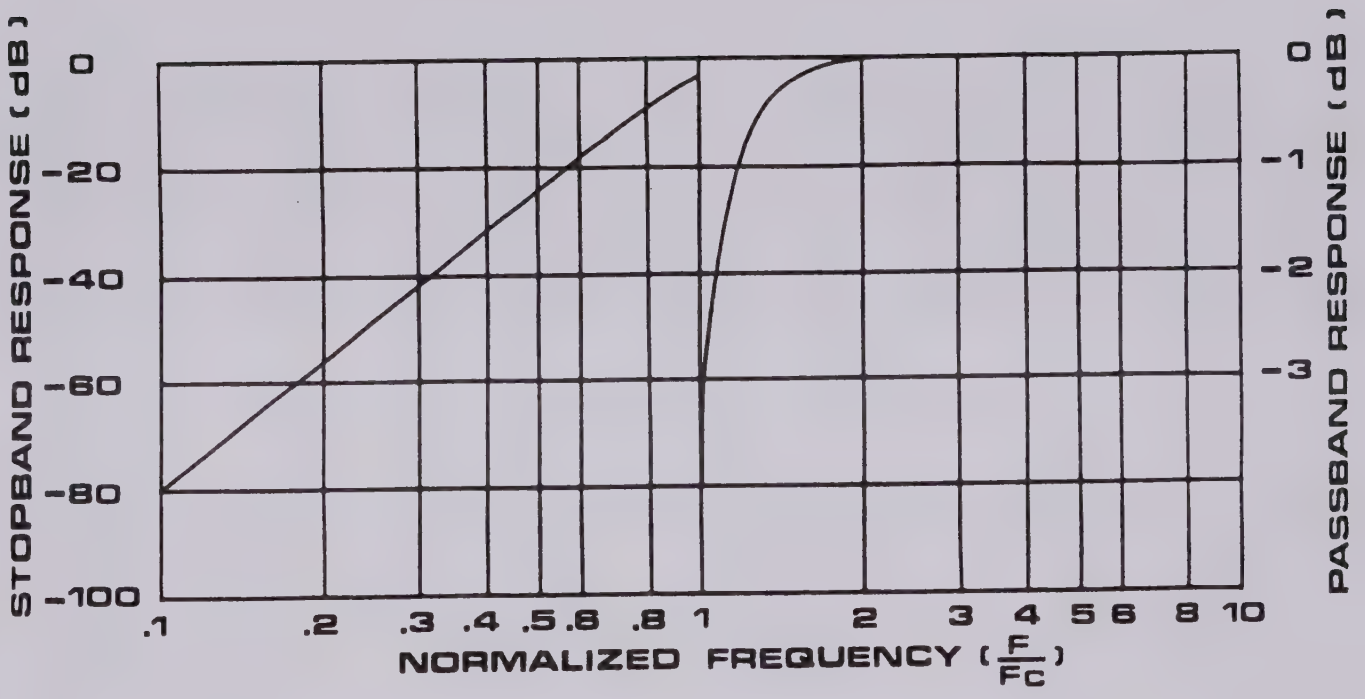


Fig. 2-4 452 Flat Ampl. Response - Hi Pass

Fig. 2-5 852 Flat Ampl. Response - Lo Pass

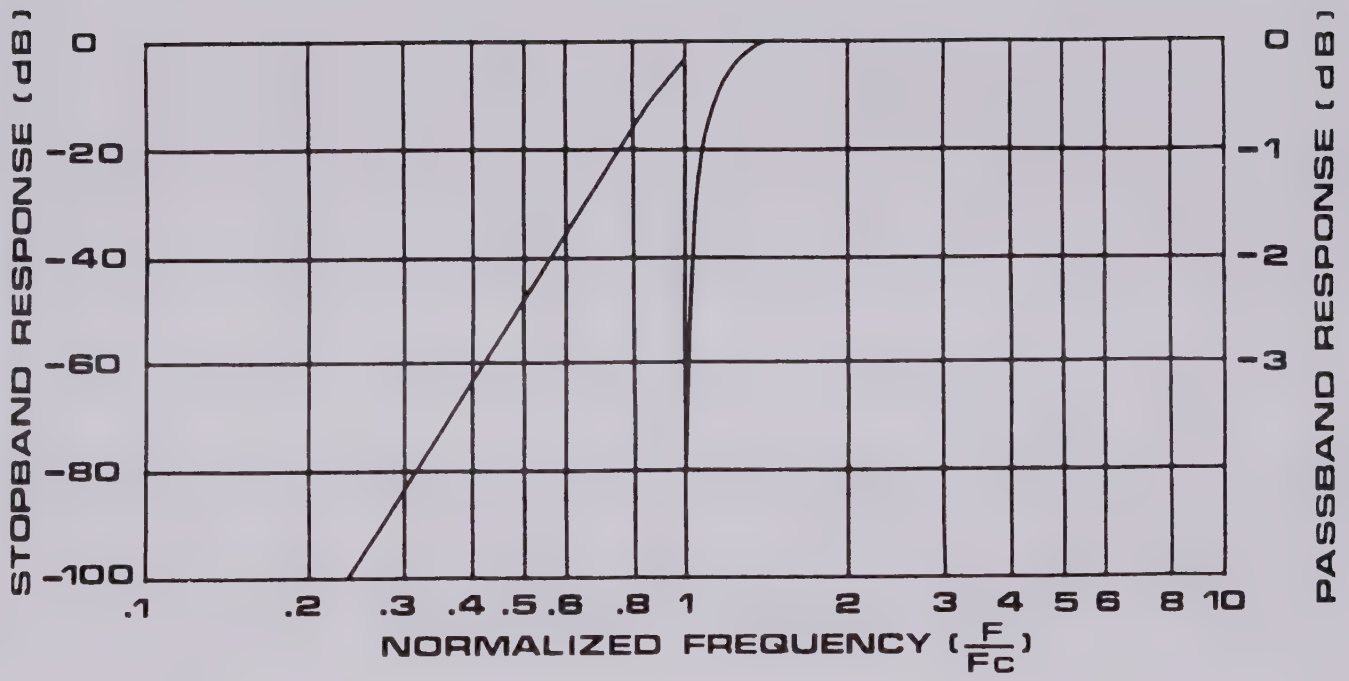


Fig. 2-6 852 Flat Ampl. Response - Hi Pass

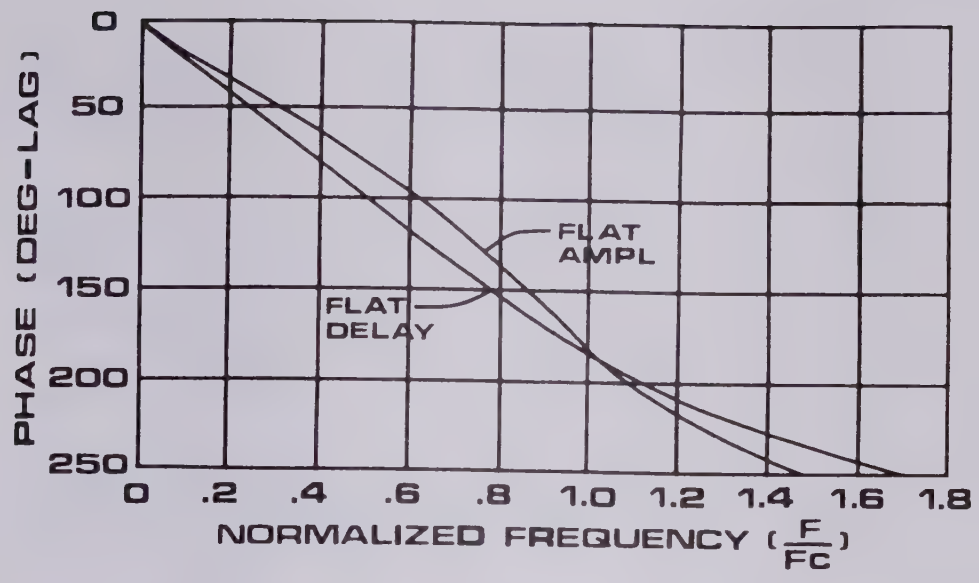


Fig. 2-7 452 Phase Response - Lo Pass

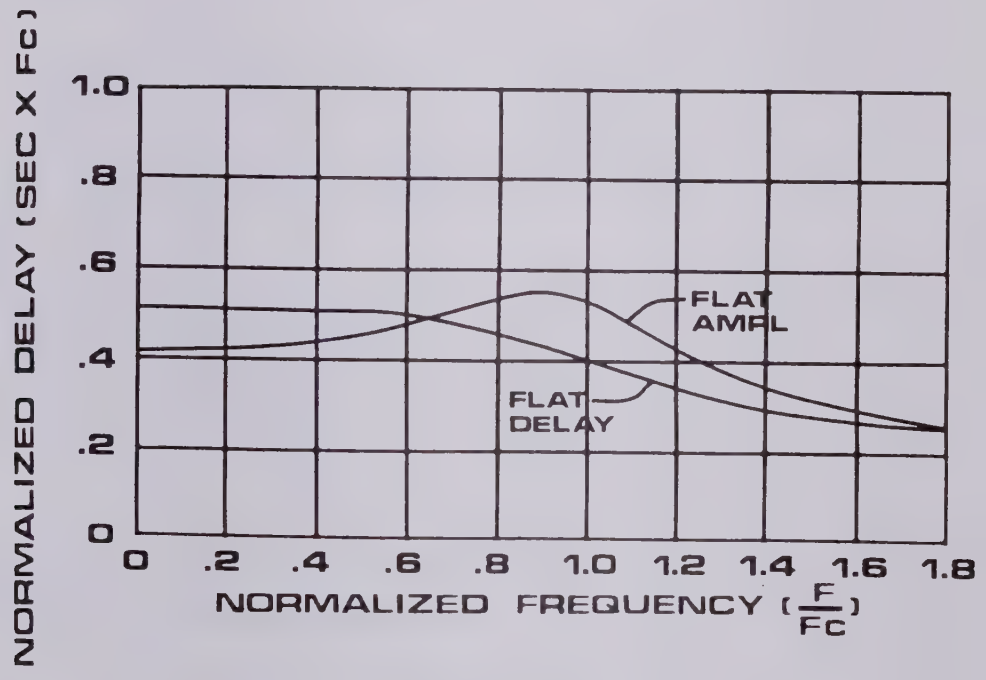


Fig. 2-8 452 Delay Response - Lo Pass

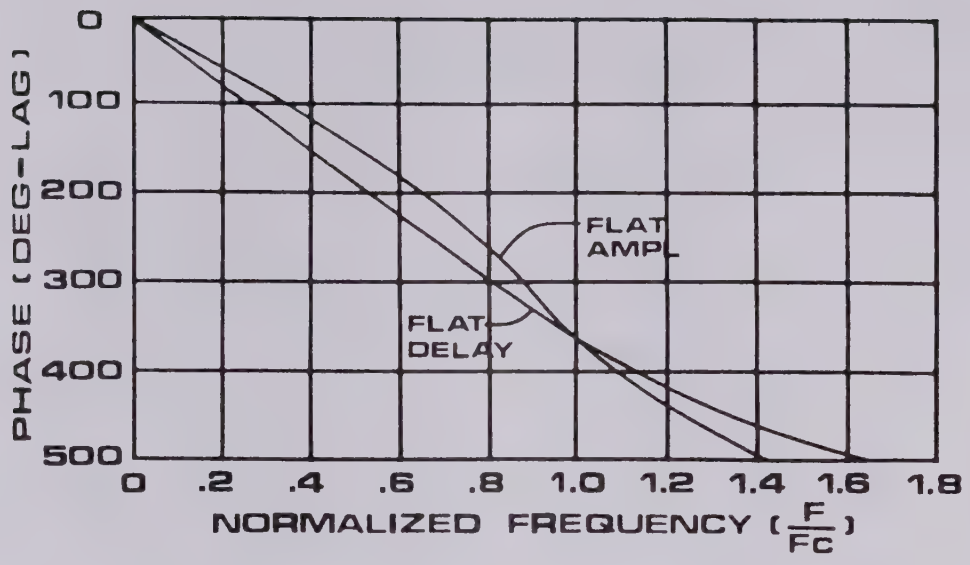


Fig. 2-9 852 Phase Response - Lo Pass

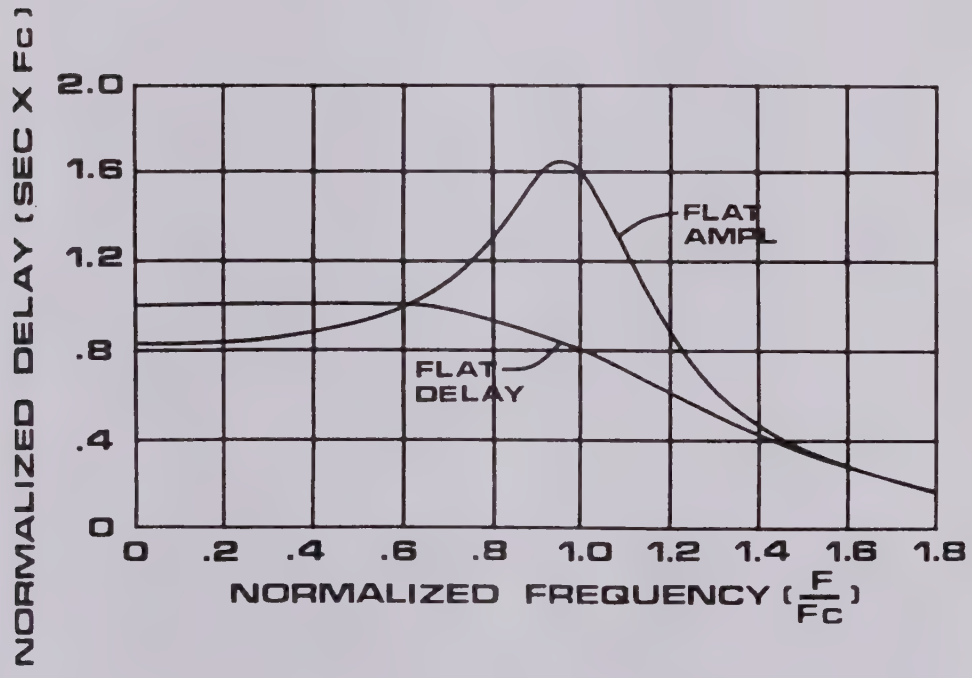
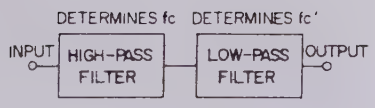
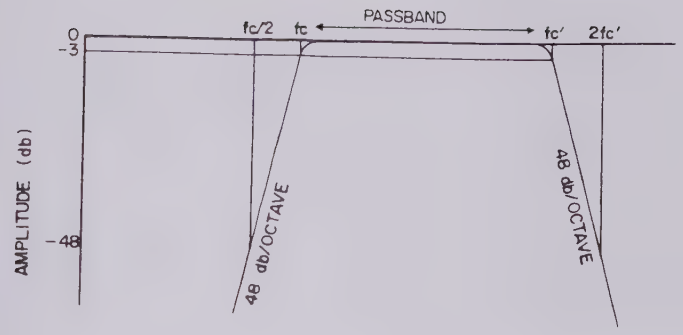
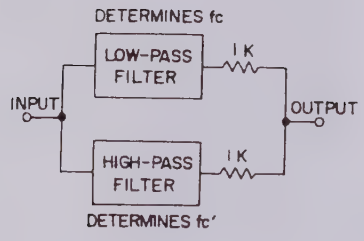


Fig. 2-10 852 Delay Response - Lo Pass

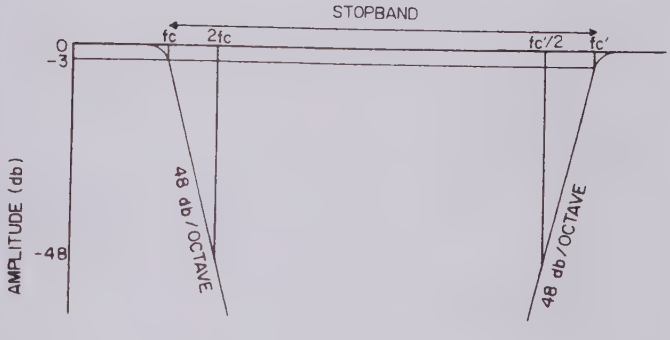


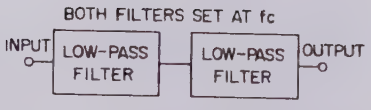
Band-Pass Filter





Band-Reject Filter





Low-Pass Filter with Doubled Rolloff

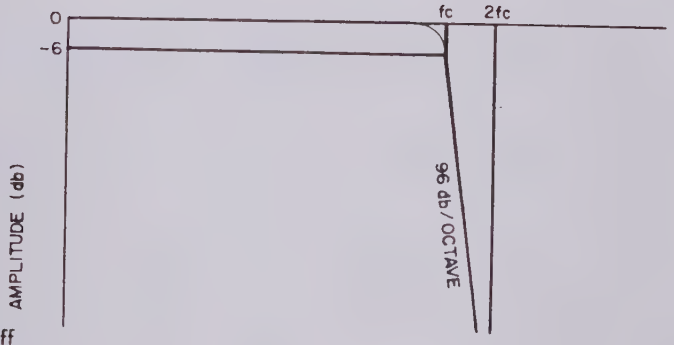


Fig. 2-11 Interconnection of Filter Channels (Model 852 Rolloff shown)

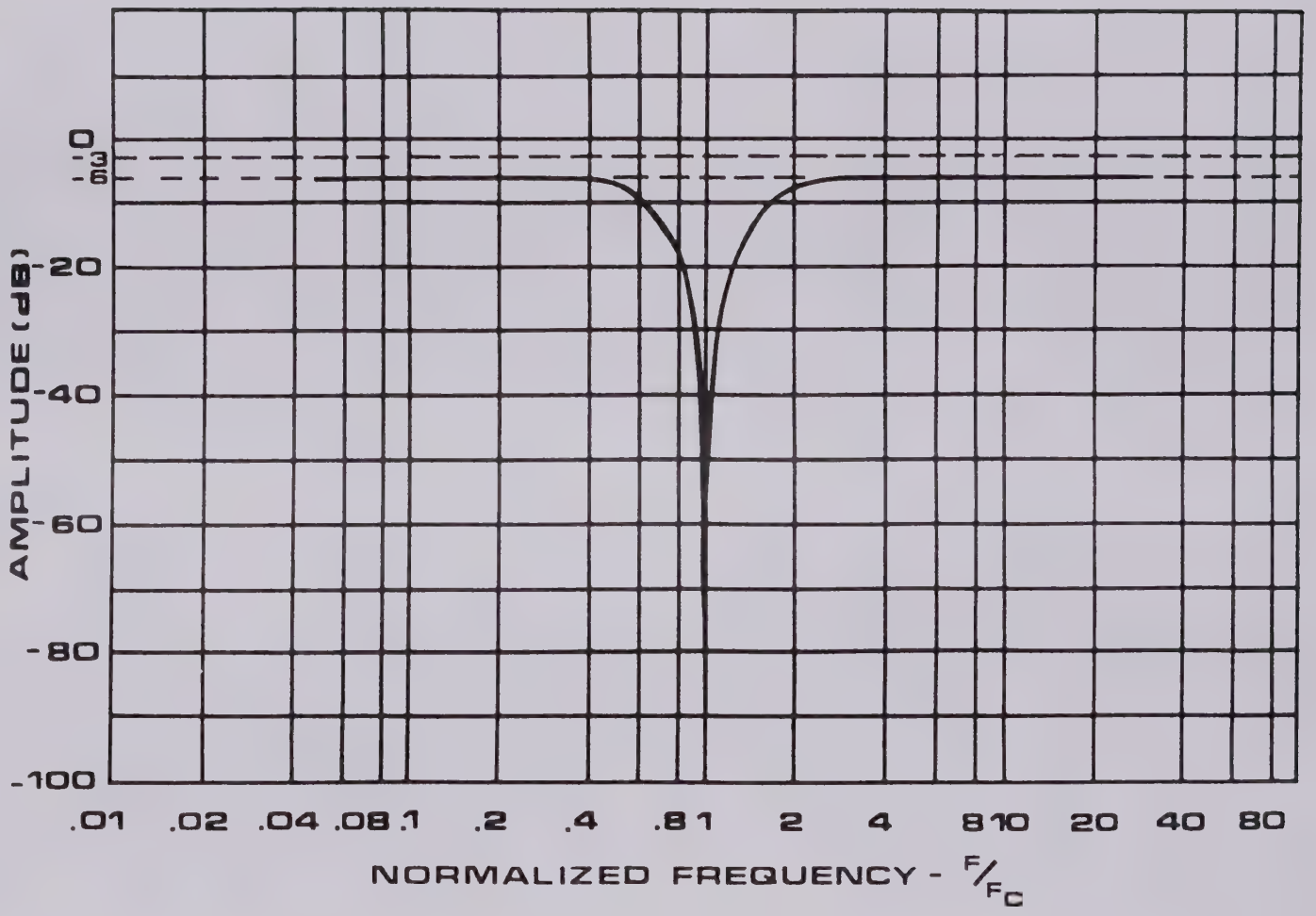


Fig. 2-12 452 Sharp Notch Response

SECTION III

PRINCIPLES OF OPERATION

3-1. INTRODUCTION

This section describes the basic principles of operation of Models 452 and 852 Dual Hi/Lo Filters. Fig. 3-1 is a Block Diagram of Model 452 and Fig. 3-2 is a Block Diagram of Model 852.

3-2. MODEL 452

The input signal of Channel 1 is applied through a 0 dB/20 dB Input Attenuator, which controls the two available gain positions, and is followed by a high input impedance buffer amplifier. The Input Attenuator provides a constant 1 Megohm input resistance in either position. The output of the Buffer amplifier is applied to a cascade of two "2nd-Order Prototypes". A "2nd-Order Prototype" is an active RC, 2nd-order (12 dB/octave) filter section which is used as a building block to synthesize higher-order filters. The gains of these stages at dc and at cutoff are as follows:

	Gain at dc	Gain at fc
Input Attenuator	0.0 dB/ - 20.0 dB	0.0 dB/ - 20.0 dB
Input Buffer	+11.8 dB	+11.8 dB
1st Prototype	+ 1.2 dB	- 4.1 dB
2nd Prototype	+ 7.0 dB	+ 9.3 dB
Overall (OUT/IN)	+20.0 dB/0.0 dB	+17.0 dB/ - 3.0 dB

Cutoff Frequency control is obtained by changing the resistors of the filter stages in 8 - 4 - 2 - 1 BCD steps. The capacitors are changed in decade steps and Option -01 adds an extra set of capacitors to extend the cutoff frequency coverage.

The output signal is available after the 2nd prototype through a 50-ohm (or, optionally, 600-ohm) resistor. The output of the buffer amplifier is available at Test Point TP - 1; the output of the 1st prototype at TP - 2.

Channel 2 is identical to Channel 1. Both channels are powered from one main power supply, through separate ± 15 V dc dual-tracking regulators.

3-3. MODEL 852

The input signal of Channel 1 is applied through a 0 dB/20 dB Input Attenuator, which controls the two available gain positions, and is followed by a high input impedance buffer amplifier. The Input Attenuator provides a constant 1 Megohm resistance in either position. The output of the Buffer amplifier is applied to a cascade of four "2nd-Order Prototypes". A "2nd-Order Prototype" is an active RC, 2nd-order (12 dB/octave) filter section which is used as a building block to synthesize higher-order filters. The gains of these stages at dc and at cutoff are as follows:

	Gain at dc	Gain at fc
Input Attenuator	0.0 dB/ - 20.0 dB	0.0 dB/ - 20.0 dB
Input Buffer	+3.4 dB	+3.4 dB
1st Prototype	+0.3 dB	-5.5 dB
2nd Prototype	+2.5 dB	-1.9 dB
3rd Prototype	+5.5 dB	+4.6 dB
4th Prototype	+8.3 dB	+16.5 dB
Overall (OUT/IN)	+20.0 dB/0.0 dB	+17.0 dB/ -3.0 dB

Cutoff Frequency control is obtained by changing the resistors of the filter in 8 - 4 - 2 - 1 BCD steps. The capacitors are changed in decade steps and Option -01 adds an extra set of capacitors to extend the cutoff frequency coverage.

The output signal is available after the 4th prototype through a 50-ohm (or, optionally, 600-ohm) resistor. The output of the buffer amplifier is available at Test Point TP - 1; the output of the 1st prototype at TP - 2; the output of the 2nd prototype at TP - 3; and the output of the 3rd prototype at TP -4.

Channel 2 is identical to Channel 1. Both channels are powered from one main power supply, through separate ± 15 V dc dual-tracking regulators.

3-4. 2nd - ORDER PROTOTYPE

Figure 3-3 is a simplified from of the low-pass 2nd-order prototype. The high-pass prototype is identical to the circuit of Figure 3-3 except that the position of resistors R and capacitors C is interchanged. In both Models the interchange is effected by the Hi Pass/Lo Pass switch.

The amplitude response of this circuit is shown in Fig. 3-4.

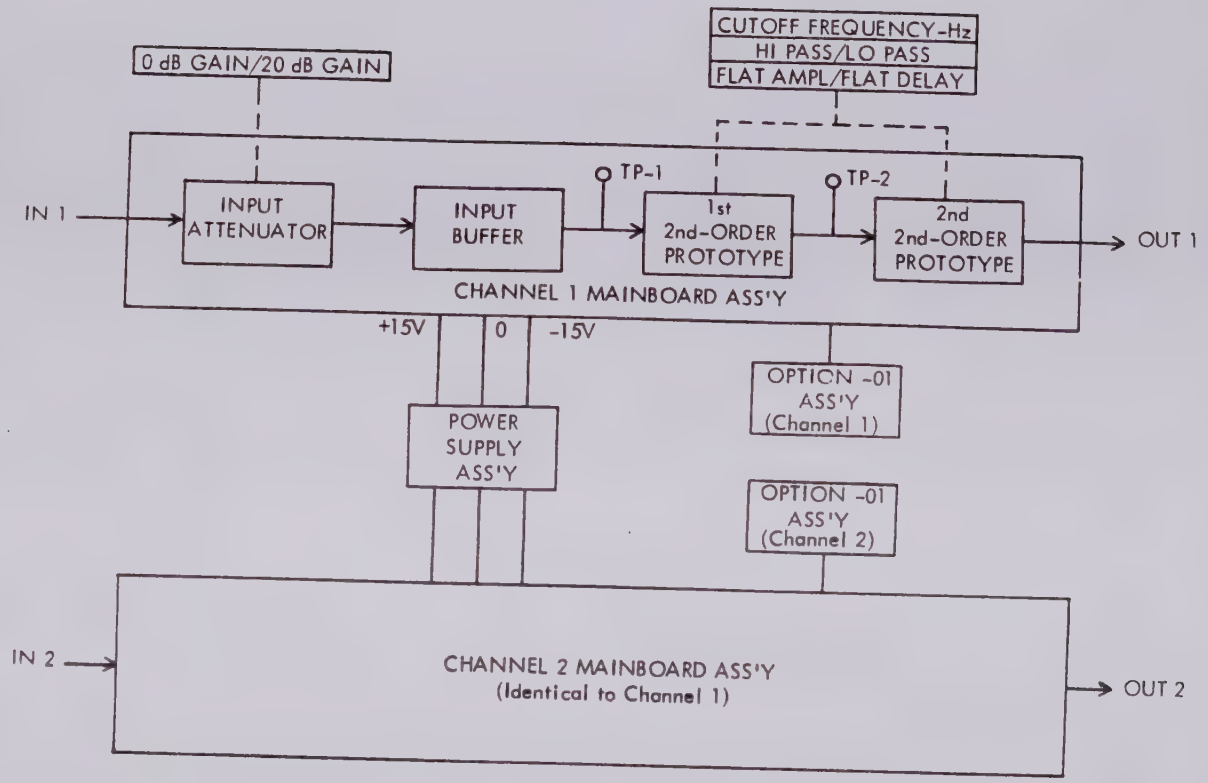


Fig. 3-1. Model 452 Block Diagram

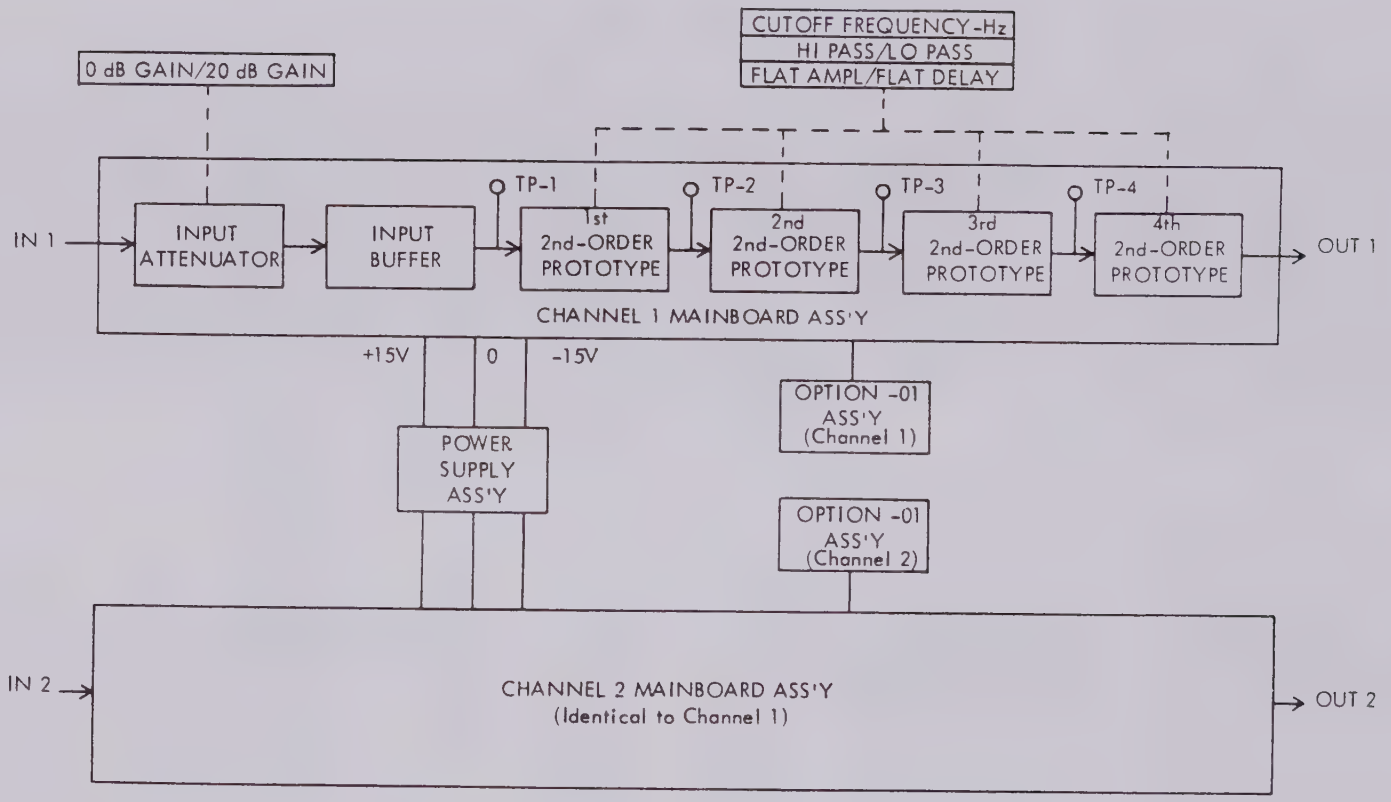


Fig. 3-2. Model 852 Block Diagram

It is seen that the response of the circuit may be altered in the vicinity of the cutoff frequency by changing the value of damping β . The damping is a function of the gain of the operational amplifier which, in turn, is determined by the ratio of resistors R1 and R2.

Likewise, the overall response of a cascade of such prototype sections may be tailored by appropriate selection of damping and the desired higher-order filter may thus be synthesized.

In the Model 452, a fourth order Flat-Amplitude, or Butterworth filter (per channel) is synthesized in this manner, while an eighth-order Butterworth filter is synthesized in the Model 852. The Flat-Delay response is obtained in either model by appropriate changes in the damping of the prototype sections.

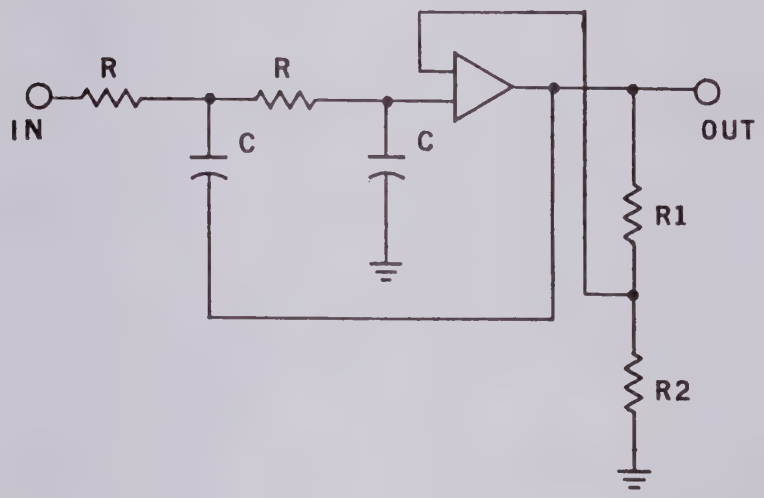


Fig. 3-3. 2nd Order Low-Pass Prototype

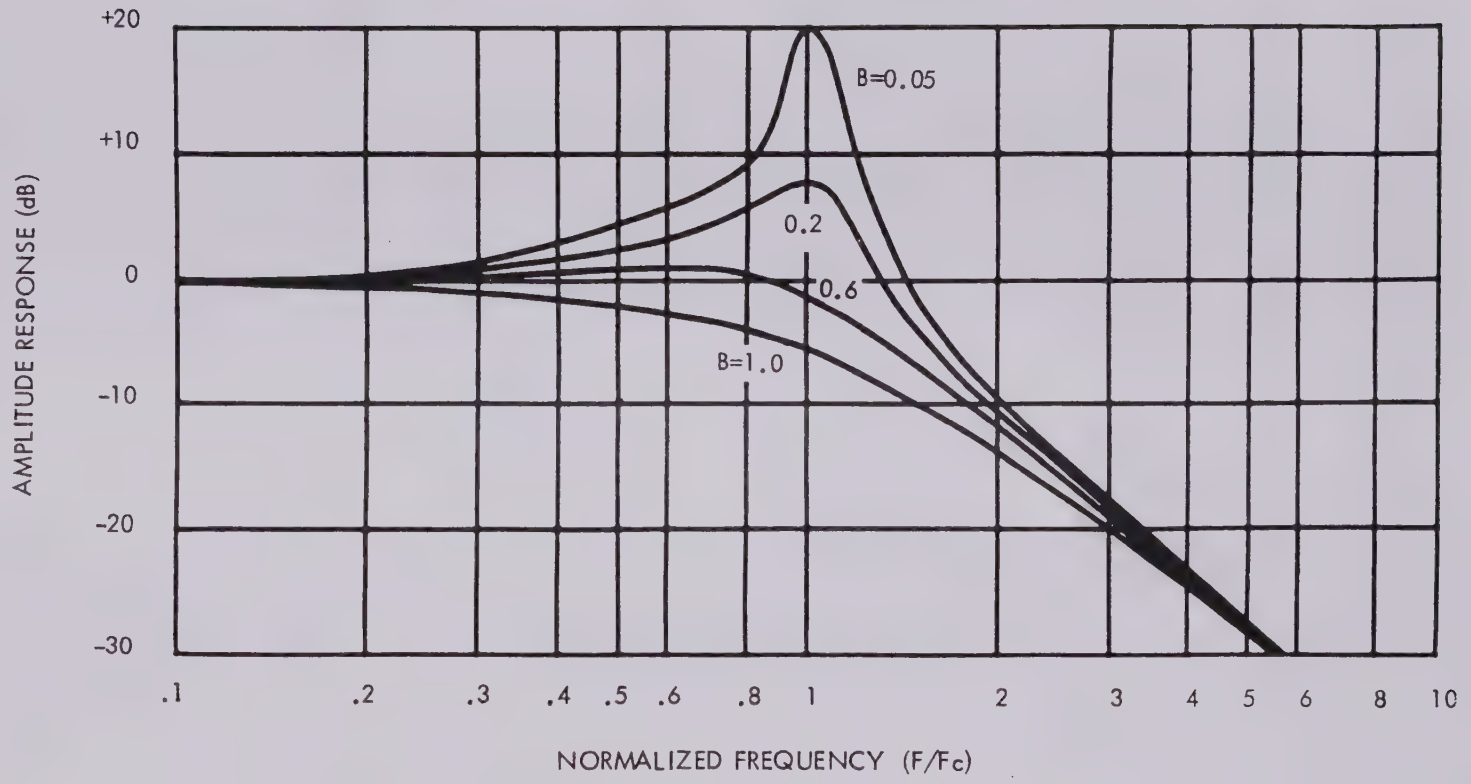


Fig. 3-4. Response of 2nd order Low-Pass Prototype for various values of damping B

SECTION IV

MAINTENANCE

4-1. INTRODUCTION

This section describes recommended test procedures to verify that the instrument meets its performance specifications. In addition, adjustment procedures are described, so that an instrument may be calibrated to meet its specifications. Troubleshooting and repair procedures are also included.

4-2. RECOMMENDED TEST EQUIPMENT

The recommended test equipment and its use is listed below:

Description (Feature)	Model	Tests
Oscilloscope	Tektronix 475	Waveform viewing
Digital Multimeter (100 uV dc resolution)	Keithley 168	DC Offset
AC Voltmeter (1% accuracy)	HP 400FL	Passband Gain, Cutoff Frequency Accuracy
RMS Voltmeter (True RMS)	Ballantine 3620A	Broadband Noise
Frequency Synthesizer (> -70 dB harmonics at 1 KHz)	Wavetek 5100	Passband Gain, Cutoff Frequency Accuracy, Max. Stopband Attenuation, Harmonic Components
Band-Pass Filter (24 dB/oct rolloff, 40 dB Gain)	Wavetek 452	Broadband Noise
Spectrum Analyzer (20 Hz - 300 KHz)	HP 141T Display 8556A LF Section 8552B IF Section	Max. Stopband Attenuation
Spectrum Analyzer (5 Hz - 50 KHz)	HP 3580A	Harmonic Components, AC Line-related Spurious

Description (Feature)	Model	Tests
Gain/Phase Meter (1 Hz - 13 MHz)	HP 3575A	Adjustments
50 - ohm Termination	-	-
5 K load resistor	-	-
1 KHz Notch Filter	Assemble as shown below	Harmonic Components

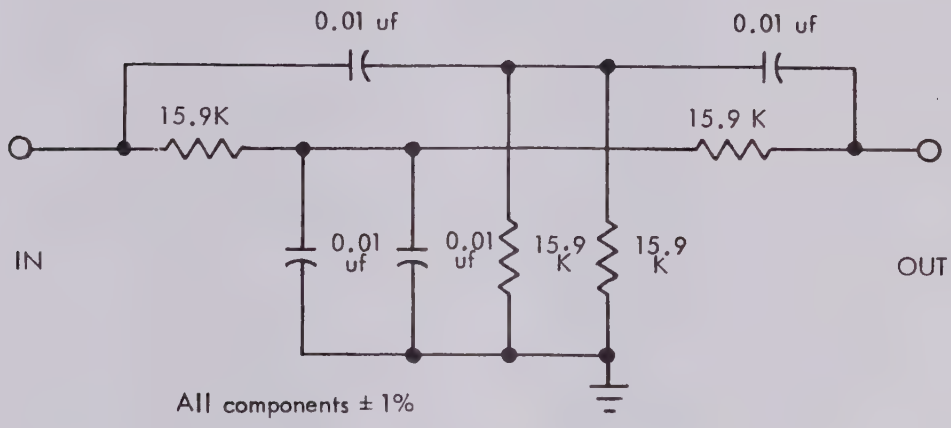
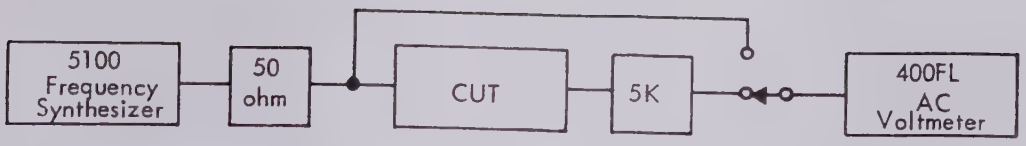


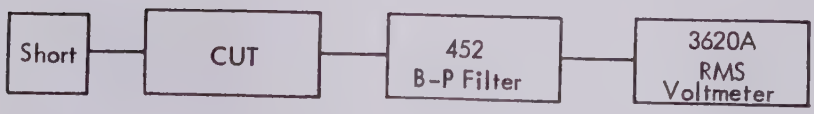
Fig. 4-1. 1 KHz Notch Filter

WARNING

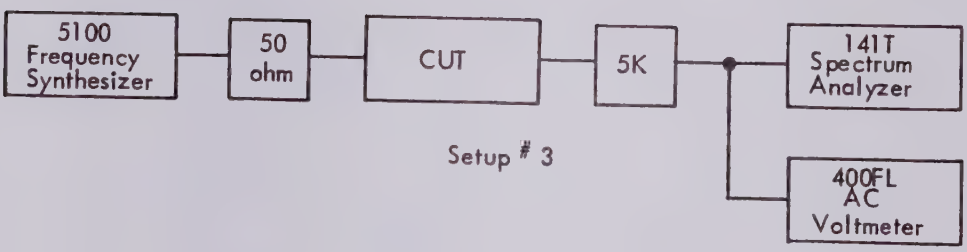
The specifications of these instruments cannot be verified, unless the recommended equipment (or equal) is utilized in test. In particular, Function Generators cannot be used in place of the recommended signal source. Function Generators produce high harmonics in their output waveform and will cause considerable errors in certain tests requiring the use of a signal source.



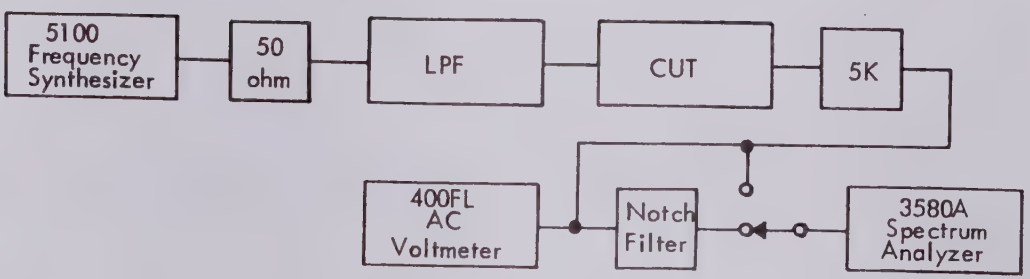
Setup # 1



Setup # 2



Setup # 3



Setup # 4

Fig. 4.2. Performance Test Setups

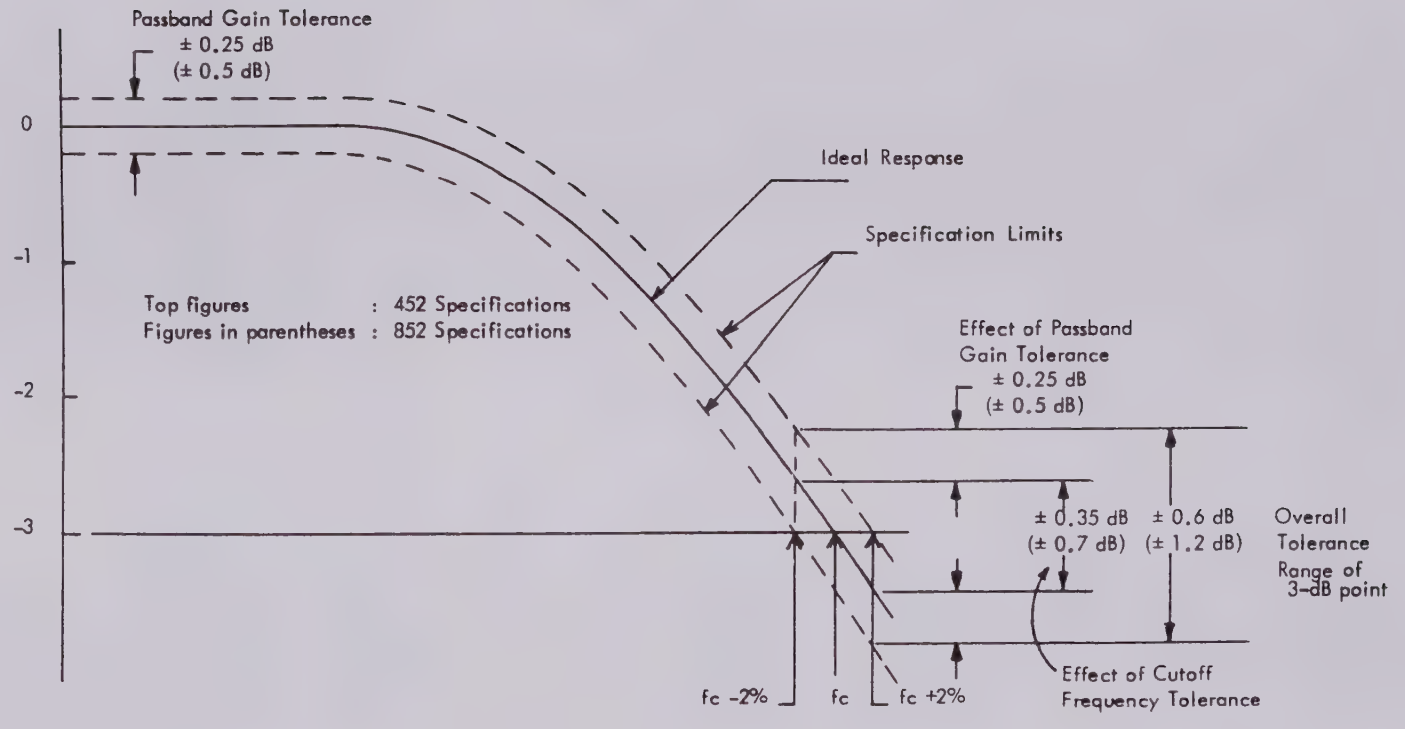


Fig. 4-3. Passband Gain & Cutoff Frequency Tolerances

4-3. PERFORMANCE TESTS

The following Performance Tests are procedures which can be used to verify that the instrument is operating properly and meets the specifications listed below. All specifications apply to Butterworth (Flat Ampl.) response and all Performance Tests are performed with the Flat Ampl./Flat Delay switch in the Flat Ampl. position.

	Specification	
Parameter	Model 452	Model 852
Passband Gain Accuracy	0 ±0.25 dB, 20 ±0.25 dB (±0.5 dB, HP, x10K)	0 ±0.5 dB, 20 ±0.5 dB (±1dB, HP, x10K)
Cutoff Frequency Calibration Accuracy	±2%	±2%
DC Offset	0±2.5 mV dc	0 ±2.5 mV dc
Broadband Noise	100 uV rms, max.	200 uV rms, max.
Maximum Stopband Attenuation*	90 dB	90 dB
Harmonic Components*	-90 dB	-80 dB
AC Line-related Spurious Components*	-110 dB	-100 dB

* relative to full-scale signal of 7.1 V rms (+17 dBV)

a. Passband Gain Accuracy (See Fig. 4-3)

Connect equipment as shown in Setup #1. Set Frequency Synthesizer output to 0.71 V rms and measure passband gain of the Channel Under Test (CUT) for the settings shown in Table 4.1.

b. Cutoff Frequency Calibration Accuracy (See Fig. 4-3)

With the equipment connected as shown in Setup #1, set CUT gain to 0 dB and the Frequency Synthesizer output to 0.0 dBV. At each Cutoff Frequency setting shown in Table 4.2 set the Synthesizer frequency equal to the Cutoff Frequency setting.

The ± 2% specification on Cutoff Frequency Calibration Accuracy is met if the output level falls within the tolerance limits shown in Fig. 4-3, namely:

Model 452 : -3dBV ± 0.6 dB
(-3dBV ± 0.85dB, in x 10K, HP)

Model 852 : -3dBV ± 1.2dB
(-3dBV ± 1.7dB, in x 10K, HP)

c. DC Offset

Connect a short across the input connector of the Channel Under Test (CUT) and the DC Multimeter across the output connector. Allow at least 10 minutes for the instrument to warm up under its own power and measure the DC Offset for the settings shown in Table 4.3.

d. Broadband Noise

Connect equipment as shown in Setup #2. Connect a short across the input connector of the Channel Under Test and set the Ground/Float switch on the rear panel to the Float position. Turn off all unused equipment in the vicinity of the test area and disconnect it from the instrument under test.

Connect the 452 Post Filter/Amplifier as a Band-Pass filter with the following settings:

CH 1: 0.01 x 10 Cutoff Frequency
Hi Pass
20 dB Gain
Flat Ampl.

CH 2: 10.00 x 10K Cutoff Frequency
Lo Pass
20 dB Gain
Flat Ampl.

With the above settings, the 452 Post Filter/Amplifier provides 40 dB of gain and establishes a noise measurement bandwidth of 0.1 Hz to 100 KHz. (A noise bandwidth of 100 KHz is, for all practical purposes, equal to the 3-dB bandwidth of a 4th-order filter.)

Measure noise with the 3620A RMS Voltmeter for the CUT settings shown in Table 4.4. Output Broadband Noise of the CUT is calculated as follows:

$$\text{Output Noise} = \frac{1}{100} \times \text{Voltmeter Reading}$$

e. Maximum Stopband Attenuation

Connect equipment as shown in Setup # 3 and set the Channel Under Test as follows:

1.00 x 10 K Cutoff Frequency
Hi Pass
20 dB Gain
Flat Ampl.

Set the 5100 Frequency Synthesizer to 100 KHz and increase its output amplitude until CUT output is equal to full-scale signal of 7.1 V rms (+17 dBV).

Set the 141T Spectrum Analyzer controls as follows:

Input Level	:	-10 dBV
Bandwidth	:	300 Hz
Scan Width	:	2 KHz/div
Scan Time	:	50 msec
Log Ref Level	:	Adjust for full-scale Display after tuning analyzer to 100 KHz

Set the CUT and input frequency to the values shown in Table 4.5. In each case, tune the Spectrum Analyzer to the input frequency and increase Input Level control setting to -60 dBV. Read the amplitude of the signal displayed on the screen. The Maximum Stopband Attenuation with respect to full-scale signal is calculated as follows:

$$A = (50\ \text{dB} + \text{Display dB})$$

f. Harmonic Components

Because of the extremely low distortion of these instruments, a special measurement procedure must be employed. The arrangement shown in Setup # 4 is recommended. Here, the unused channel of the instrument is employed as a Low-Pass Filter to reduce the harmonic components of the 5100 Frequency Synthesizer to levels of -100 dB or less. The output of the Channel Under Test (CUT) is viewed on the 3580 A Spectrum Analyzer directly, or through a passive Notch Filter centered on the measurement frequency. For the values shown, the Notch Filter will attenuate the fundamental (1 KHz) by at least 50 dB, while the 2nd harmonic is attenuated 10 dB and the 3rd harmonic 6 dB.

Set the Synthesizer frequency to 1.000 KHz and the Low Pass Filter to a Cutoff Frequency of 1.00 x 1 K, 0 dB Gain, Flat Ampl. response. Set the Channel Under Test as follows:

1.00 x 10 Cutoff Frequency
Hi Pass
20 dB Gain
Flat Ampl.

Increase Synthesizer amplitude until full-scale signal of 7.1 V rms (+ 17 dBV) appears at the output of the CUT.

Connect the 3580 A Spectrum Analyzer to the output of the CUT and set its controls as follows:

Bandwidth	:	30 Hz
Freq. Span	:	.5 KHz/div
Sweep Time	:	1 sec/div
Display	:	LOG, 10 dB
Input Sensitivity	:	+ 10 dBV
Input Sensitivity Vernier	:	Adjust to obtain full-scale (0 dB) Display at 1 KHz.
Amplitude Ref Level	:	Normal

Connect the Spectrum Analyzer to the output of the Notch Filter and increase Input Sensitivity to -30 dBV. Read the amplitude of each harmonic component displayed on the screen. Harmonic Components at the output of the CUT with respect to full-scale signal are calculated as follows:

2nd Harmonic = -(40 dB + 2nd Harm. Display dB) + 10 dB
3rd Harmonic = -(40 dB + 3rd Harm. Display dB) + 6 dB
4th Harmonic = -(40 dB + 4th Harm. Display dB) + 4 dB

g. A-C Line-related Spurious Components

Connect a short across the input connector of the Channel Under Test and the 3580A Spectrum Analyzer to the output connector. Set the Ground/Float switch on the rear panel to the Float position and turn off all other equipment in the vicinity of the test area. Disconnect all other equipment from the instrument under test.

Set the Channel Under Test as follows:

10.00 x 10 K Cutoff Frequency
Lo Pass
0 dB Gain
Flat Ampl.

Set the 3580A Spectrum Analyzer controls as follows:

Input Sensitivity	:	-30 dBV
Input Sensitivity Vernier	:	CAL
Bandwidth	:	3 Hz
Freq. Span	:	20 Hz/div
Sweep Time:	:	5 sec/div
Display	:	LOG, 10 dB
Amplitude Ref Level	:	Normal

Obtain a complete sweep on the analyzer screen and measure the amplitude of the Display at line frequency and multiples (x2, x3) of the line frequency. Line-related spurious components at the output of the CUT with respect to full-scale signal (+ 17 dBV) are calculated as follows:

Spurious = - (47 dB + Display dB)

PERFORMANCE TEST RESULTS

Wavetek Model 452 Option- Test By _____

Dual Hi/Lo Filter Date _____

Serial Number _____

Channel 1 | 2

Table 4.1. Passband Gain Accuracy

Cutoff Frequency	Mode	Gain	Input Frequency	Passband Gain Specification	Measured	
10.00 x 1K	LP	0 dB	1 KHz	0 ± .25 dB		
10.00 x 1K	LP	20 dB	1 KHz	20 ± .25 dB		
1.00 x 1K	HP	0 dB	10 KHz	0 ± .25 dB		
1.00 x 1K	HP	20 dB	10 KHz	20 ± .25 dB		
1.00 x 10K	HP	0 dB	100 KHz	0 ± .5 dB		
1.00 x 10K	HP	20 dB	100 KHz	20 ± .5 dB		

Table 4.2. Cutoff Frequency Calibration Accuracy

Cutoff Frequency	Mode	Input Frequency	Output level Specification Limits	Measured	
10.00 x 10K	LP	100.0 KHz	-2.40 dBV to -3.60 dBV		
10.00 x 10K	HP	100.0 KHz	-2.15 dBV to -3.85 dBV		
1.00 x 10K	LP	10.0 KHz	-2.40 dBV to -3.60 dBV		
1.00 x 10K	HP	10.0 KHz	-2.15 dBV to -3.85 dBV		
10.00 x 1K	LP	10.0 KHz	-2.40 dBV to -3.60 dBV		
10.00 x 1K	HP	10.0 KHz	-2.40 dBV to -3.60 dBV		
10.00 x 100	LP	1.0 KHz	-2.40 dBV to -3.60 dBV		
10.00 x 100	HP	1.0 KHz	-2.40 dBV to -3.60 dBV		
10.00 x 10	LP	100 Hz	-2.40 dBV to -3.60 dBV		
10.00 x 10	HP	100 Hz	-2.40 dBV to -3.60 dBV		
Option-01:					
10.00 x 1	LP	10 Hz	-2.40 dBV to -3.60 dBV		
10.00 x 1	HP	10 Hz	-2.40 dBV to -3.60 dBV		

Table 4.2. Cutoff Frequency Calibration Accuracy - continued

Cutoff Frequency	Mode	Input Frequency	Output level Specification limits	Measured
10.00 x 1K	LP	10.00 KHz	-2.40 dBV to -3.60 dBV	
9.00 x 1K	LP	9.00 KHz	-2.40 dBV to -3.60 dBV	
8.00 x 1K	LP	8.00 KHz	-2.40 dBV to -3.60 dBV	
7.00 x 1K	LP	7.00 KHz	-2.40 dBV to -3.60 dBV	
6.00 x 1K	LP	6.00 KHz	-2.40 dBV to -3.60 dBV	
5.00 x 1K	LP	5.00 KHz	-2.40 dBV to -3.60 dBV	
4.00 x 1K	LP	4.00 KHz	-2.40 dBV to -3.60 dBV	
3.00 x 1K	LP	3.00 KHz	-2.40 dBV to -3.60 dBV	
2.00 x 1K	LP	2.00 KHz	-2.40 dBV to -3.60 dBV	
1.00 x 1K	LP	1.00 KHz	-2.40 dBV to -3.60 dBV	
1.00 x 1K*	LP	1.00 KHz	-2.40 dBV to -3.60 dBV	
0.90 x 1K	LP	900 Hz	-2.40 dBV to -3.60 dBV	
0.80 x 1K	LP	800 Hz	-2.40 dBV to -3.60 dBV	
0.70 x 1K	LP	700 Hz	-2.40 dBV to -3.60 dBV	
0.60 x 1K	LP	600 Hz	-2.40 dBV to -3.60 dBV	
0.50 x 1K	LP	500 Hz	-2.40 dBV to -3.60 dBV	
0.40 x 1K	LP	400 Hz	-2.40 dBV to -3.60 dBV	
0.30 x 1K	LP	300 Hz	-2.40 dBV to -3.60 dBV	
0.20 x 1K	LP	200 Hz	-2.40 dBV to -3.60 dBV	
0.10 x 1K	LP	100 Hz	-2.40 dBV to -3.60 dBV	
0.10 x 1K*	LP	100 Hz	-2.40 dBV to -3.60 dBV	
0.09 x 1K	LP	90 Hz	-2.40 dBV to -3.60 dBV	
0.08 x 1K	LP	80 Hz	-2.40 dBV to -3.60 dBV	
0.07 x 1K	LP	70 Hz	-2.40 dBV to -3.60 dBV	
0.06 x 1K	LP	60 Hz	-2.40 dBV to -3.60 dBV	
0.05 x 1K	LP	50 Hz	-2.40 dBV to -3.60 dBV	
0.04 x 1K	LP	40 Hz	-2.40 dBV to -3.60 dBV	
0.03 x 1K	LP	30 Hz	-2.40 dBV to -3.60 dBV	
0.02 x 1K	LP	20 Hz	-2.40 dBV to -3.60 dBV	
0.01 x 1K	LP	10 Hz	-2.40 dBV to -3.60 dBV	

* Use the "10" of the next lower digit to obtain this setting.

Table 4.3. D.C. Offset

Cutoff Frequency	Mode	Gain	Specification	Measured
10.00 x 10K	LP	0 dB	± 2.5mV dc	
10.00 x 10K	LP	20 dB	± 2.5 mV dc	
0.01 x 10	HP	0 dB	± 2.5 mV dc	
0.01 x 10	HP	20 dB	± 2.5 mV dc	

Table 4.4. Broadband Noise

Cutoff Frequency	Mode	Gain	Specification	Measured
10.00 x 10K	LP	0 dB	100 uV rms, max	
10.00 x 10K	LP	20 dB	100 uV rms, max	
0.01 x 10	HP	0 dB	100 uV rms, max	
0.01 x 10	HP	20 dB	100 uV rms, max	

Table 4.5. Maximum Stopband Attenuation

Cutoff Frequency	Mode	Input Frequency	Specification	Measured
1.00 x 10K	LP	200 KHz	80 dB	
10.00 x 10K	HP	5 KHz	80 dB	

Table 4.6. Harmonic Components

	Specification	Measured
2nd Harmonic	-90 dB	
3rd Harmonic	-90 dB	
4th Harmonic	-90 dB	

Table 4.7. Line-Related Spurious Components

	Specification	Measured
Line Frequency	-110 dB	
2 x Line Frequency	-110 dB	
3 x Line Frequency	-110 dB	

Wavetek Model 852 Option-

Dual Hi/Lo Filter

Serial Number _____

Channel 1 | 2

Test By _____

Date _____

Table 4.1. Passband Gain Accuracy

Cutoff Frequency	Mode	Gain	Input Frequency	Passband Gain Specification	Measured	
10.00 x 1K	LP	0 dB	1 KHz	0 ± .5 dB		
10.00 x 1K	LP	20 dB	1 KHz	20 ± .5 dB		
1.00 x 1K	HP	0 dB	10 KHz	0 ± .5 dB		
1.00 x 1K	HP	20 dB	10 KHz	20 ± .5 dB		
1.00 x 10K	HP	0 dB	100 KHz	0 ± 1 dB		
1.00 x 10K	HP	20 dB	100 KHz	20 ± 1 dB		

Table 4.2. Cutoff Frequency Calibration Accuracy

Cutoff Frequency	Mode	Input Frequency	Output level Specification Limits	Measured	
10.00 x 10K	LP	100.0 KHz	-1.8 dBV to -4.2 dBV		
10.00 x 10K	HP	100.0 KHz	-1.3 dBV to -4.7 dBV		
1.00 x 10K	LP	10.0 KHz	-1.8 dBV to -4.2 dBV		
1.00 x 10K	HP	10.0 KHz	-1.3 dBV to -4.7 dBV		
10.00 x 1K	LP	10.0 KHz	-1.8 dBV to -4.2 dBV		
10.00 x 1K	HP	10.0 KHz	-1.8 dBV to -4.2 dBV		
10.00 x 100	LP	1.0 KHz	-1.8 dBV to -4.2 dBV		
10.00 x 100	HP	1.0 KHz	-1.8 dBV to -4.2 dBV		
10.00 x 10	LP	100 Hz	-1.8 dBV to -4.2 dBV		
10.00 x 10	HP	100 Hz	-1.8 dBV to -4.2 dBV		
Option -01:					
10.00 x 1	LP	10 Hz	-1.8 dBV to -4.2 dBV		
10.00 x 1	HP	10 Hz	-1.8 dBV to -4.2 dBV		

Table 4.2. Cutoff Frequency Calibration Accuracy - continued

Cutoff Frequency	Mode	Input Frequency	Output level Specification Limits	Measured	
10.00 x 1K	LP	10.00 KHz	-1.8 dBV to -4.2 dBV		
9.00 x 1K	LP	9.00 KHz	-1.8 dBV to -4.2 dBV		
8.00 x 1K	LP	8.00 KHz	-1.8 dBV to -4.2 dBV		
7.00 x 1K	LP	7.00 KHz	-1.8 dBV to -4.2 dBV		
6.00 x 1K	LP	6.00 KHz	-1.8 dBV to -4.2 dBV		
5.00 x 1K	LP	5.00 KHz	-1.8 dBV to -4.2 dBV		
4.00 x 1K	LP	4.00 KHz	-1.8 dBV to -4.2 dBV		
3.00 x 1K	LP	3.00 KHz	-1.8 dBV to -4.2 dBV		
2.00 x 1K	LP	2.00 KHz	-1.8 dBV to -4.2 dBV		
1.00 x 1K	LP	1.00 KHz	-1.8 dBV to -4.2 dBV		
1.00 x 1K*	LP	1.00 KHz	-1.8 dBV to -4.2 dBV		
0.90 x 1K	LP	900 Hz	-1.8 dBV to -4.2 dBV		
0.80 x 1K	LP	800 Hz	-1.8 dBV to -4.2 dBV		
0.70 x 1K	LP	700 Hz	-1.8 dBV to -4.2 dBV		
0.60 x 1K	LP	600 Hz	-1.8 dBV to -4.2 dBV		
0.50 x 1K	LP	500 Hz	-1.8 dBV to -4.2 dBV		
0.40 x 1K	LP	400 Hz	-1.8 dBV to -4.2 dBV		
0.30 x 1K	LP	300 Hz	-1.8 dBV to -4.2 dBV		
0.20 x 1K	LP	200 Hz	-1.8 dBV to -4.2 dBV		
0.10 x 1K	LP	100 Hz	-1.8 dBV to -4.2 dBV		
0.10 x 1K*	LP	100 Hz	-1.8 dBV to -4.2 dBV		
0.09 x 1K	LP	90 Hz	-1.8 dBV to -4.2 dBV		
0.08 x 1K	LP	80 Hz	-1.8 dBV to -4.2 dBV		
0.07 x 1K	LP	70 Hz	-1.8 dBV to -4.2 dBV		
0.06 x 1K	LP	60 Hz	-1.8 dBV to -4.2 dBV		
0.05 x 1K	LP	50 Hz	-1.8 dBV to -4.2 dBV		
0.04 x 1K	LP	40 Hz	-1.8 dBV to -4.2 dBV		
0.03 x 1K	LP	30 Hz	-1.8 dBV to -4.2 dBV		
0.02 x 1K	LP	20 Hz	-1.8 dBV to -4.2 dBV		
0.01 x 1K	LP	10 Hz	-1.8 dBV to -4.2 dBV		

* Use the "10" of the next lower digit to obtain this setting.

Table 4.3. D.C. Offset

Cutoff Frequency	Mode	Gain	Specification	Measured
10.00 x 10K	LP	0 dB	± 2.5 mV dc	
10.00 x 10K	LP	20 dB	± 2.5 mV dc	
0.01 x 10	HP	0 dB	± 2.5 mV dc	
0.01 x 10	HP	20 dB	± 2.5 mV dc	

Table 4.4. Broadband Noise

Cutoff Frequency	Mode	Gain	Specification	Measured
10.00 x 10K	LP	0 dB	200 uV rms, max	
10.00 x 10K	LP	20 dB	200 uV rms, max	
0.01 x 10	HP	0 dB	200 uV rms, max	
0.01 x 10	HP	20 dB	200 uV rms, max	

Table 4.5. Maximum Stopband Attenuation

Cutoff Frequency	Mode	Input Frequency	Specification	Measured
1.00 x 10K	LP	200 KHz	80 dB	
10.00 x 10K	HP	5 KHz	80 dB	

Table 4.6. Harmonic Components

	Specification	Measured
2nd Harmonic	-80 dB	
3rd Harmonic	-80 dB	
4th Harmonic	-80 dB	

Table 4.7. Line-Related Spurious Components

	Specification	Measured
Line Frequency	-100 dB	
2 x Line Frequency	-100 dB	
3 x Line Frequency	-100 dB	

4-4. ADJUSTMENTS*

a. DC Offset Adjustment

This adjustment may be performed if the output dc level is determined to be out of specification. The adjustment should be performed after allowing at least 10 minutes for the instrument to warm up under power. Connect a short across the input connector of the instrument and the DC Multimeter across the output connector. Perform the adjustments shown below:

Cutoff Freq.	Mode	Gain	Response	Adjustment and 452 : Vo	Output V 852 : Vo
10.00 x 1K	Hi Pass	20 dB	Flat Ampl.	R23 : ±2.5 mV	R27 : ± 2.5 mV
0.01 x 1K	Lo Pass	20 dB	Flat Ampl.	R8 : ±2.5 mV	R8 : ± 2.5 mV

b. Attenuator Response Adjustment

This adjustment may be performed if the response at 100 KHz in high-pass mode and 0 dB gain is out of specification. Connect the Frequency Synthesizer to the input of the instrument and the Gain/Phase Meter betwen input and output. Use the following settings:

Input Frequency : 100 KHz / 1 KHz
Amplitude : 1.0 V rms
Filter Settings : 5.00 x 10
Hi Pass
0 dB Gain
Flat Ampl.

Model 452: Adjust C1 to obtain same gain at 100 KHz as at 1 KHz (within ± 0.25 dB)

Model 852: Adjust C1 to obtain same gain at 100 KHz as at 1 KHz (within ± 0.5 dB)

c. Gain Adjustment

This adjustment may be performed if the passband gain, or the attenuation at the cutoff frequency is determined to be out of specification. Connect the 5100 Frequency Synthesizer to the input of the instrument and the 400FL AC Voltmeter to the appropriate points indicated below. Proceed as follows:

---

* The Frequency Synthesizer should be terminated with 50 ohms and the Filter Channel under adjustment should be terminated with 5K.

Model 452

1. Set filter settings as follows:
   5.00 x 100
   Lo Pass
   0 dB Gain
   Flat Amplitude
2. Set input frequency to 500 Hz. Connect the AC Voltmeter to TP-1 and adjust input amplitude to obtain a reading of -10.0 dBV.
3. Move the AC Voltmeter to TP-2 and verify a reading of -14.1 dBV (± 0.1 dB).
4. Move the AC Voltmeter to OUT and adjust R19 to obtain a reading of -4.8 dBV.
5. Change filter setting to 5.00 x 1K and adjust R11 to obtain a reading of -1.8 dBV at OUT.

Model 852

1. Set filter settings as follows:
   5.00 x 100
   Lo Pass
   0 dB Gain
   Flat Amplitude
2. Set input frequency to 500 Hz. Connect the AC Voltmeter to TP-1 and adjust input amplitude to obtain a reading of -10.0 dBV.
3. Move the AC Voltmeter to TP-2 and verify a reading of -15.5 dBV (± 0.1 dB).
4. Move the AC Voltmeter to TP-3 and adjust R19 to obtain a reading of -17.4 dBV.
5. Move the AC Voltmeter to TP-4 and adjust R24 to obtain a reading of -12.8 dBV.
6. Move the AC Voltmeter to OUT and adjust R31 to obtain a reading of +3.6 dBV.
7. Change filter setting to 5.00 x 1K and adjust R11 to obtain a reading of +6.6 dBV at OUT.

d. High Frequency (x 10K) Cutoff Adjustment

This adjustment may be performed if cutoff frequency in the x 10K position is determined to be out of specification, while other positions are within specification. It should also be performed if the Gain adjustment described above has been performed. Connect the Frequency Synthesizer to the input of the instrument and the Gain/Phase meter to the appropriate points shown below. Use the following settings

	A	B	C
Input Frequency :	50.0 KHz	100.0 KHz	50.0 KHz
Amplitude :	1.0 V rms	1.0 V rms	1.0 V rms
Filter Settings :	5.00 x 10K	1.00 x 10K	5.00 x 10K
	Lo Pass	Hi Pass	Hi Pass
	0 dB Gain	0 dB Gain	0 dB Gain
	Flat Amplitude	Flat Amplitude	Flat Amplitude

Model 452: Perform the following adjustments:

Gain/Phase meter connected between:	TP-1 & TP-2	TP-2 & OUT	IN & OUT
A - Alternately adjust:	C29 & C34	C39 & C44	C39 & C44
to obtain Gain (dB):	-4.1 ± 0.2	+9.3 ± 0.2	-3.0 ± 0.2
and Phase (deg):	90 ± 1	90 ± 3	180 ± 4
B - Adjust: to obtain Gain (dB):			R16 0.0 + 0.1
C - Adjust: to obtain Gain (dB):			R21 -3.0 ± 0.0

Model 852: Perform the following adjustments:

Gain/Phase meter connected between:	TP-1 & TP-2	TP-2 & TP-3	TP-3 & TP-4	TP-4 & OUT	IN & OUT
A - Alternately Adjust:	C29 & C34	C39 & C44	C49 & C54	C59 & C64	C59 & C64
to obtain Gain (dB):	-5.5 ± 0.2	-1.9 ± 0.2	+4.6 ± 0.2	+16.5 ± 0.2	-3.0 ± 0.5
& Phase (deg):	90 ± 1	90 ± 1	90 ± 2	90 ± 6	180 ± 8
B - Adjust:					R16
to obtain Gain (dB):					0 + 0.2
C - Adjust:					R33
to obtain Gain (dB):					-3.0 ± 0.0

4-5. TROUBLESHOOTING PROCEDURES

a. 1st Level Troubleshooting

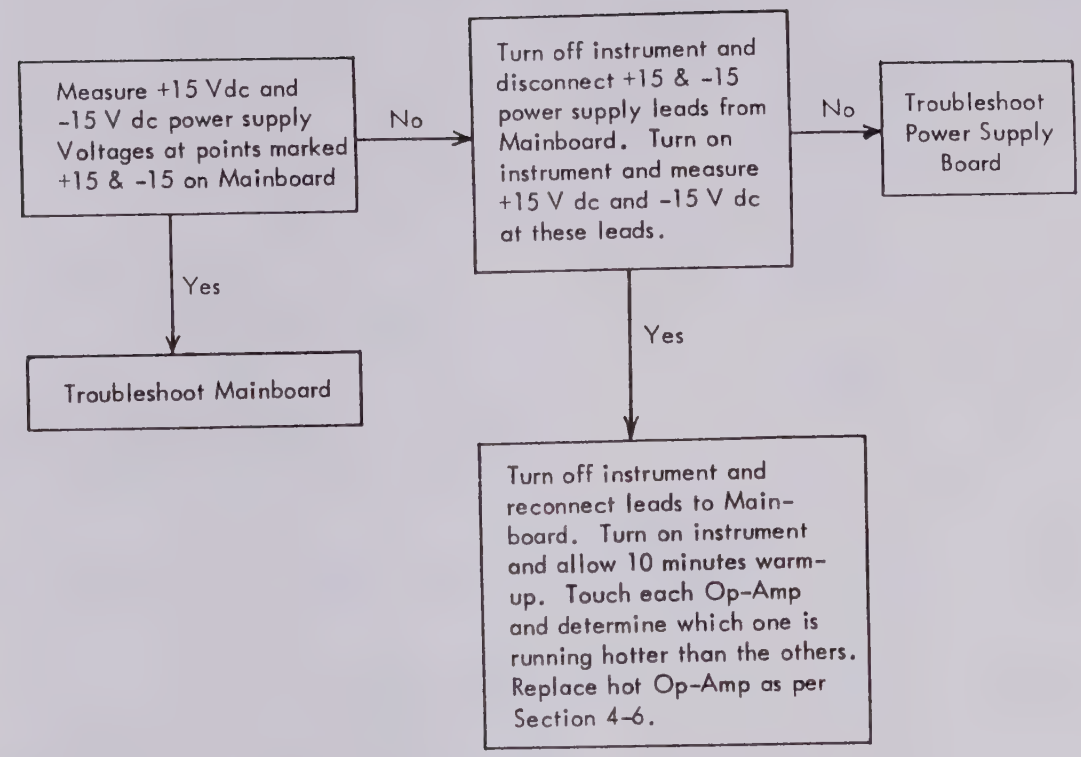
If both LED indicators fail to operate when the power switch is in the ON position:

1. Make certain that line power is available to the instrument.
2. Check that the 115/230 volt switch is in proper position for the available line voltage.
3. Check the fuse and replace, if defective.
4. With the power switch in the ON position check continuity of the power cord with an ohmmeter.
5. Check proper functioning of the Floating Operation switch by verifying a short/open between the third wire of the power cord and the shell of one of the BNC connectors.

If one LED indicator is on and the other is off, troubleshoot the Power Supply board (see 3rd Level Troubleshooting).

b. 2nd Level Troubleshooting

1. If both indicators are on but the instrument fails to operate, remove the hardware that secures the top and bottom covers to the rear panel; slide back and remove top and bottom covers.
2. Perform the procedure in the order given in the 2nd Level Troubleshooting Tree. Voltages (±0.25 Volts) given in this Tree are measured with respect to ground using a Digital Multimeter (See Section 4-2 for Recommended Test Equipment).


Measure +15 Vdc and -15 V dc power supply Voltages at points marked +15 & -15 on Mainboard
No
Turn off instrument and disconnect +15 & -15 power supply leads from Mainboard. Turn on instrument and measure +15 V dc and -15 V dc at these leads.
No
Troubleshoot Power Supply Board
Yes
Troubleshoot Mainboard
Yes
Turn off instrument and reconnect leads to Mainboard. Turn on instrument and allow 10 minutes warm-up. Touch each Op-Amp and determine which one is running hotter than the others. Replace hot Op-Amp as per Section 4-6.

2nd Level Troubleshooting Tree

c. 3rd Level Troubleshooting : Power Supply Board

1. To gain access to the Power Supply board, proceed as follows:

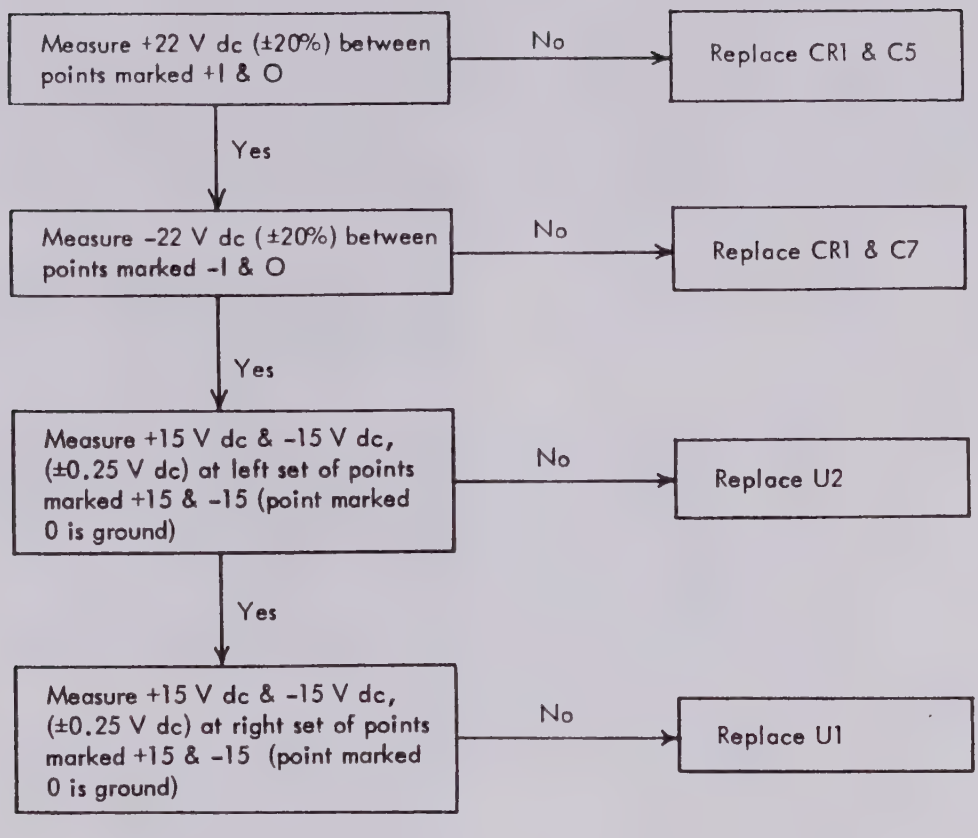
   a. Remove the two screws which fasten the Rear Panel to the Side Frames and pull back the Rear Panel.

   b. Remove the two screws which fasten the Power Supply Shield Box to the Rear Panel and move the Shield Box forward.

   c. Remove the four screws which fasten the Power Supply board to the Rear Panel standoffs. Disconnect Power Supply leads from Mainboards and move Power Supply board out of the Shield Box.

2. Perform the procedure in the order given in the 3rd Level Trouble-shooting Tree. Voltages given in this Tree are measured with respect to ground using a Digital Multimter (See Section 4-2. for Recommended Test Equipment).

3. Repair as per Section 4-6, and replace by reversing the previous procedure.


Measure +22 V dc (±20%) between points marked +1 & O
No
Replace CR1 & C5
Yes
Measure -22 V dc (±20%) between points marked -1 & O
No
Replace CR1 & C7
Yes
Measure +15 V dc & -15 V dc, (±0.25 V dc) at left set of points marked +15 & -15 (point marked 0 is ground)
No
Replace U2
Yes
Measure +15 V dc & -15 V dc, (±0.25 V dc) at right set of points marked +15 & -15 (point marked 0 is ground)
No
Replace U1

3rd Level Troubleshooting Tree: Power Supply board

d. 4th Level Troubleshooting: Mainboard

1. Set filter channel controls as follows:
   5.00 x 1K
   Lo Pass
   0 dB Gain
   Flat Amplitude

2. Apply input signal at 500 Hz and adjust its amplitude to 0.0 dBV.

3. Perform the procedure in the order given in the 4th Level Trouble-shooting Tree. Voltages (±0.2 dB) given in this Tree are measured with respect to ground using an AC Voltmeter (See Section 4-2. for Recommended Test Equipment).

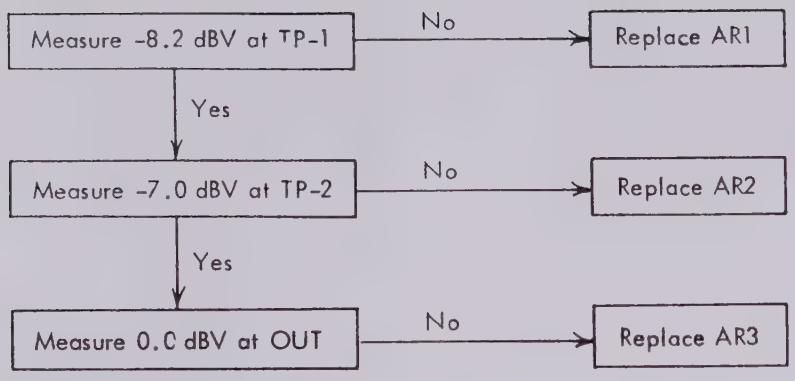
4. If replacement of any component is required, access to the bottom of the Mainboard is either readily available, or, if behind one of the Support Bars, it may be made available as follows:

   a. Remove the three screws from each Mainboard that fasten them to the Support Bar.

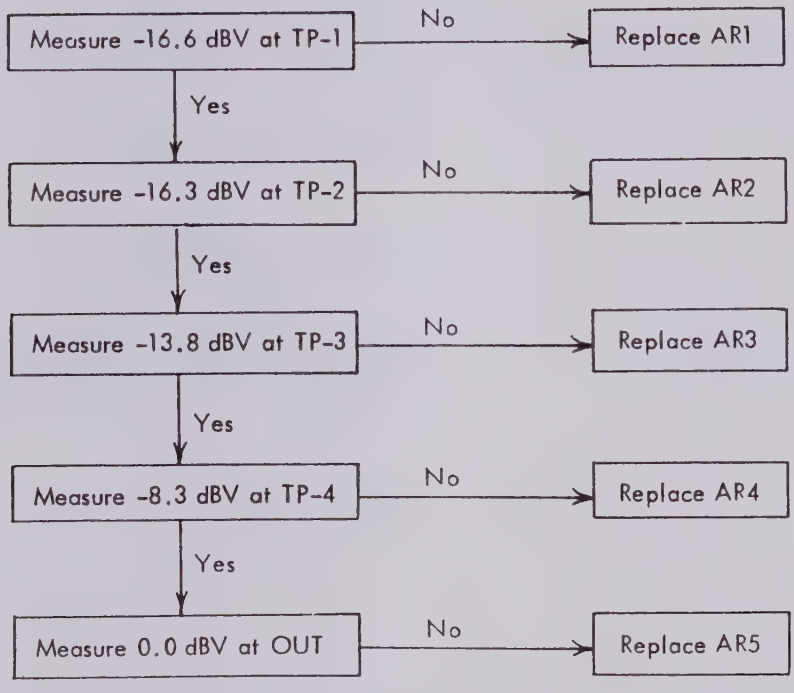
   b. Remove all fastening nuts from the Shield Board (between channels) and lift Shield Board supporting lugs out of the holes in Support Bars.

   c. Remove the two screws which fasten the Support Bar to the Side Frames. Lift Mainboards slightly and slide Support Bar forwards (or backwards) to expose desired area on bottom of Mainboard.

   d. Repair as per Section 4-6. and replace by reversing the above procedure.



Model 452



Model 852

4th Level Troubleshooting Tree: Mainboard

4.6 PRINTED CIRCUIT BOARD REPAIR

When replacing integrated circuits or other electronic components soldered to printed-circuit boards, the procedures indicated below should be followed to prevent potential damage to the board.

1. Determine by troubleshooting techniques, which component has failed.

2. Remove the defective component from the board by cutting the pins or leads with a small diagonal clipping tool. (Always remove and replace the entire component.)

3. Apply heat (40-50 W soldering iron) sparingly to each of the cut pins or leads and remove from the board; clean the hole(s) with a toothpick or solder suction tool.

4. Form the tinned leads of the replacement part and insert in the printed circuit holes; solder, then trim leads to extend 1/16-inch beyond the back surface of the board. (Use only 63-37 solder with maximum 1/16 -inch diameter.)

5. When soldering semiconductor devices and all small components, be sure to use a heat sink tool or long-nosed plier connected to the component lead(s) while each is being soldered. Allow the soldered connection to cool before removing the heat sink.

6. Clean all dirt and solder-flux from the printed circuit traces by liberal application of isopropyl alcohol or freon-type solvents.

4-7 POWER SUPPLY REMOVAL

Step 1 - Remove top and bottom covers.

Step 2 - Remove center conductor from all four BNC connectors on the rear panel. Be very careful not to move or bend center conductor. (It is very susceptible to breaking).

Step 3 - The ribbon cable coming out of the power supply shield should be disconnected from the boards it's going to, noting wiring configuration.

Step 4 - Unscrew the 5/16 inch nut to remove the power switch from the front panel.

Step 5 - Unscrew the four cable ties on the side panel.

Step 6 - Using a flat blade screw driver in behind the power supply shield, pry out the black "Hayco" grommet. Cut any cable ties if needed.

Step 7 - Remove the two screws holding the rear panel to side frame and the two screws holding the power supply shield to rear panel and let the panel lay down flat. (If an 01 option is installed, remove the two screws from the right angle bracket to the stand off of the capacitor packs).

Step 8 - Lift the power supply shield up and move it to the side as much as you need to remove the four screws holding the power supply board in.

Step 9 - Unsolder the five wires from the line cord and power switch co-ax cable on the power supply board noting wiring configuration.

Step 10- The power supply board can now be removed for repair or replacement.

SECTION V

REPLACEABLE PARTS LISTS & DIAGRAMS

5-1 DRAWINGS

The following assembly drawings, parts lists and schematics are in the arrangement shown below.

5-2 ERRATA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, errata pages are prepared to summarize the changes made and are inserted in the shipping carton with this manual. If no such pages exist, the manual is correct as printed.

5-3 ORDERING PARTS

When ordering spare parts, please specify part number, circuit reference, next higher assembly and unit serial number.

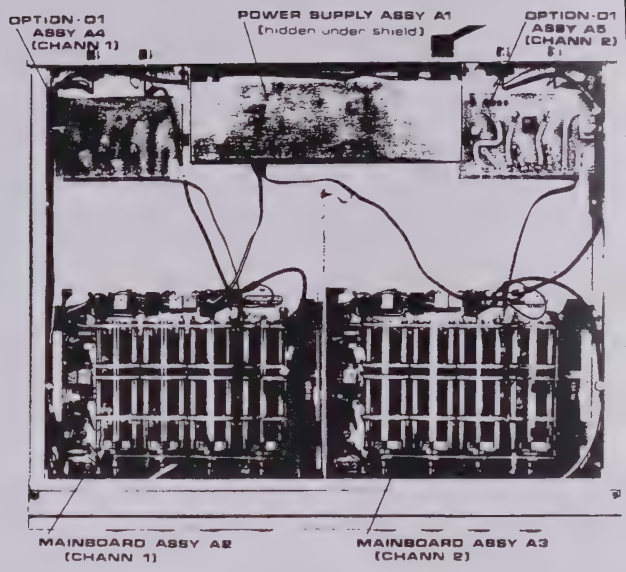
NOTE

An assembly drawing number is not necessarily the assembly part number. However, the assembly parts list number is the assembly part number.

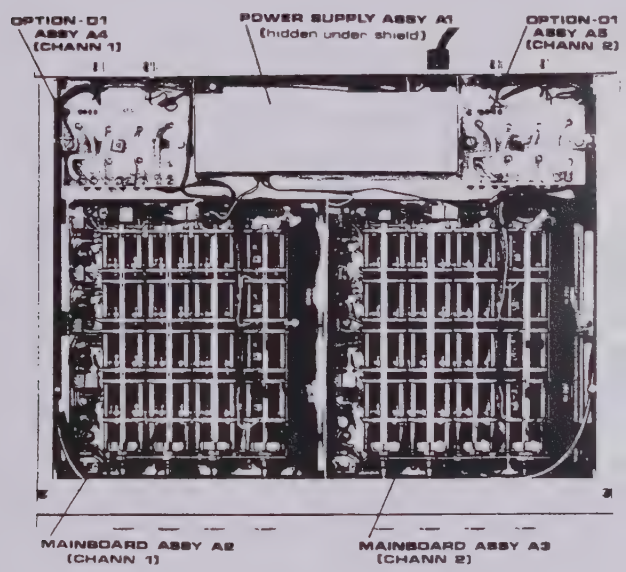
The number etched into a PC board is the board part number. The assembly (PC board and components on the board) part number is stamped on the board.

DRAWING		DRAWING NUMBER
Top Assembly Parts List	Model 452	000.0950
	Model 452-01	000.0951
Subassembly Parts List	Model 452	002.0950
Mainboard Schematic	Model 452	03-004-0960
Mainboard Assembly	Model 452	02-004-0960
Mainboard Parts List	Model 452	004.0960

DRAWING		DRAWING NUMBER
Subassembly Parts List	Model 452-01	002.0951
Multiplier Schematic	Model 452-01	03-004-0980
Multiplier Assembly/Parts List	Model 452-01	02-004-0980
Top Assembly Parts List	Model 852	000.0900
	Model 852-01	000.0901
Subassembly Parts List	Model 852	002.0900
Mainboard Schematic	Model 852	03-004-0930
Mainboard Assembly	Model 852	02-004-0930
Mainboard Parts List	Model 852	004.0930
Subassembly Parts List	Model 852-01	002.0901
Multiplier Schematic	Model 852-01	03-004-0940
Multiplier Assembly/Parts List	Model 852-01	02-004-0940
Front Panel Parts List	Models 452/852	001.0900
Rear Panel Parts List	Models 452/852	002.0985
Power Supply Schematic	Models 452/852	03-004-0950
Power Supply Assembly	Models 452/852	02-004-0950
Power Supply Parts List	Models 452/852	004.0950



Model 452-01



Model 852-01

Fig. 5-1 Assembly Designation

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REV	ECO	BY	DATE	APP'D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	SUBASSY 452 ANALOG FILTER			002 0950	1
NONE	BOTTOM COVER ASSY BLACK			002 3092	1
NONE	LABEL, SERIAL NUMBER/FILTERS & SYNTHESIZERS	FBS-8660	WVTK	1400 01 8660	1
NONE	COVER TOP, BLACK	MPV-40464-14	BURLEY	303 0101	1
NONE	M SCR ST IN PHIL 6-32X1/4			381 6042	4

WAVETEK PARTS LIST

TITLE: DUAL CHANNEL 452

ASSEMBLY NO: 000 0950

REV: D

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	SUBASSY 452-01 ANALOG FILTER			002 0951	1
NONE	BOTTOM COVER ASSY BLACK			002 3092	1
NONE	LABEL, SERIAL NUMBER/FILTERS & SYNTHESIZERS	FBS-8660	WVTK	1400-01-8660	1
NONE	COVER TOP, BLACK	MPV-40464-14	BURLEY	303 0101	1
NONE	M SCR ST IN PHIL 6-32X1/4			381 6042	4

WAVETEK PARTS LIST

TITLE: DUAL CHANNEL 452 W/RANGE EXT OPTION 001

ASSEMBLY NO: 000 0951

REV: D

PAGE 1

WAVETEK SAN DIEGO, CALIFORNIA

TITLE	MODEL NO	DWG NO	REV
PARTS LIST TOP ASSEMBLY	452	000 0950	D
	452-001	000 0951	D
	FSCM NO 23338	SHEET 1 OF 1	

NOTE: UNLESS OTHERWISE SPECIFIED

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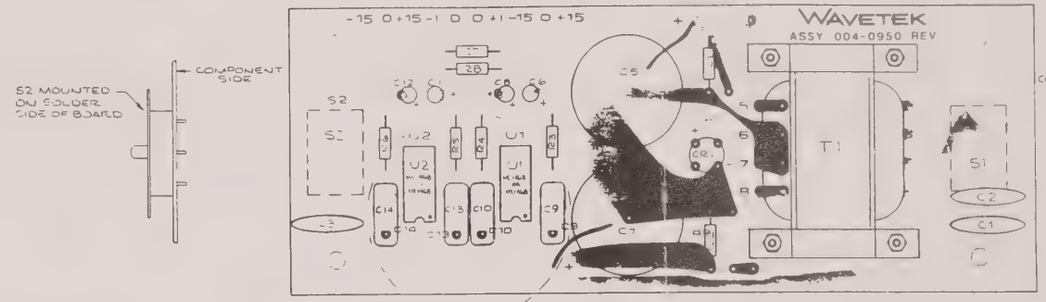

DETAIL 'A'

STANDARD CONFIGURATION

U1 & U2 ARE MC1468 OR NE1468 (120-0152) ITEM # 20
C9, C10, C13, & C14 ARE .0015uF (105-2150) ITEM # 7
REFER TO MAIN ASSEMBLY DRAWING.

ALTERNATE CONFIGURATION

U1 & U2 ARE SG 4501 (120-0157) ITEM # 30
C9, C10, C13, & C14 ARE .01uF (100-3101) ITEM # 29
REFER TO DETAIL "A".

NOTICE

THE ACTUAL CIRCUIT BOARD ETCH MAY BE DIFFERENT THAN THAT SHOWN HERE. REFER TO THE SCHEMATIC DRAWING FOR CORRECT COMPONENT CONNECTIONS.

NOTE:
1- LEAD PROTRUSION THRU BOARD TO BE .062" MAX

2- SHEET No 2 IS A SIZE L/M

DRAWN BY	-	DATE
CHECKED BY		
ENG APPV.	[illegible]	
MFG APPV.		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE
.XXX ± .005
.XX ± .01
FRA ± 1/64
ANG ± 1°

WAVETEK [illegible]

TITLE: ASSEMBLY POWER SUPPLY

SIZE: D | DRAWING NO: 02-004-0950 | REV: G

SCALE: 2/1

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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR PART NO	MFGR	WAVETEK NO	QTY/PT
C5 C7	CAP ELECT 300UF 63V	530D251G063GE6	SPRAG	109 7500	
NONE	ASSY PRE WAVE LOAD 852 0930	852-0938	WVTK	1208 00 0938	
F1	1FMR 34V CT @ 300MA PC MT	DPC-34 300	SIGN	177 3012	
S2	S BLIDE DPDT (PC MT)	11A-1308	SWCFT	342 2202	
S1	S BLIDE DPDT (1157220 PC MT)	11A 1380	SWCFT	342 2203	
NONE	BRACKET 1FMR MTG (177 3012)	10 BR	BIGN	361 6001	
NONE	SLVNG PLASTIC FIBROUS 18AWG	FIF130-18	ALPHA	378 5181	d
NONE	M ICR ST ZN SL 4 40X3/8 PH	2900 38-4106	WVTK	380 4062	*
NONE	NUT HX ST ZN 4 40X1/4 AF			387 4000	*
NONE	WASHER FLAT STL ZN #4	2800-26 4000	WVTP	388 0040	*
NONE	WASHER EXT LK STL ZN #8			388 1161	

WAVETEK PARTS LIST

TITLE: SPK POWER SUPPLY ASSY ANALOG

ASSEMBLY NO: 004 095K

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART NO	MFGR	WAVETEK NO	QTY/PT
C1 C2 C3	CAP CER .01UF 0MV 1KV	DD-103	CRL	100 3100	3
C10 C13 C14 C9	CAP PLSTR .0015UF 10% 100V	225P15291WD3	SPRGE	105 2150	4
C11 C12 C6 C8	CAP TANT 10UF 20% 35V	T355A104M035AS	KEMET	109 4100	4
R3 R4 R5 R6	RES.CFLM 10 OHM 5% 1/4W	CF 1/4 10 OHM 5%	STKPL	116 0101	4
R7 R8	RES.CFLM 2 2K OHM 5% 1/4W	CF 1/4 2 2K OHM 5%	STKPL	116 2221	2
R1 R2	RES.CFLM 15K OHM 5% 1/4W	R25JE15K	ROHM	116 3151	2
U1 U2	8 DL VOLT REG 15V 100MA DIP	MC1468L	MOT	120 0152	2
NONE	ASSY PC BD PREPPED 852 0930	852 2539	WVTK	1208-00 2539	1
CR1	SIL FWB 50PIV 1 5A	PF-05	EDI	130 0140	1

WAVETEK PARTS LIST

TITLE: ASSY PRE WAVE LOAD 852-0930

ASSEMBLY NO: 1208 00 2539

PAGE 1

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE
MATERIAL	CHECKED	
	PROJ ENGR	
FINISH WAVETEK PROCESS	RELEASE APPROVAL	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX .XXX	WAVETEK TITLE
	SIZE D	FSCM NO 23338 DWG NO REV
	SCALE	WEIGHT SHEET OF

NOTE UNLESS OTHERWISE SPECIFIED

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REV	ECO	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
3	SPK POWER SUPPLY ASSY (452/852)			004 0950	1
7	FUSE 3AG 1/4A SB 250V	312 250	LITFU	165 4000	1
9	SUPER KIT	2900-0852-02	WVTK	2900-0852-02	1
16	LOCKWASHER, INTERNAL STAR, PLATED #6	#6 LOCKWASHER	CHRCL	2800-24-6000	4
1	PANEL, REAR 452/852			303 0620	1
2	SHIELD, POWER SUPPLY (452/852)			303 0907	1
4	CONN, COAX BULKHD RECPT 180L	31-010	AMPH	351 0006	4
6	FUSE HOLDER, MINI 3 AG	031 1633/031 1666	BCHUR	351 9951	1
8	STRAIN REL, SVT-3 136 PANEL	SR-SL-1BLK	MEYCO	367 1101	1
9	SNAP BUSHING 3/8 IN PLASTIC BLK	SB375-4BLK	MEYCO	367 1104	1
10	WIRE, #18 AWG STR BLACK	1118/19	MEICO	378 1404	4
11	POWER CORD, 3 COND GRY	172393	BELDN	378 4003	1

WAVETEK PARTS LIST	TITLE: PANEL ASSY REAR	ASSEMBLY NO: 002 0985	REV: E

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	SHRINK TBG PLYFIN BLACK 1/4 IN	FIT-105-1/4	ALPHA	378 3540	75
13	M SCR ST ZN PH 6-32X3/8 PH			381 6062	2
14	M SCR ST ZN PHP 6-32X1/2 BH	2800-38-6103	WVTK	381 6081	4
12	SHRINK, CLEAR, 3/4	FP-301-3/4	ELCHC	6001-21-2000	1.5

WAVETEK PARTS LIST	TITLE: PANEL ASSY REAR	ASSEMBLY NO: 002 0985	REV: E

PAGE 2

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK San Diego, California
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	PROJ ENGR		
FINISH: WAVETEK PROCESS	RELEASE APPROV		
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ±1/64, DECIMALS .XX ±.01, .XXX ±.005, ANGLES ±1°		SIZE: D; FSCM NO: 23338; DWG NO: 002 0985; REV: E; SCALE; MODEL 452/852; SHEET 1 OF 1

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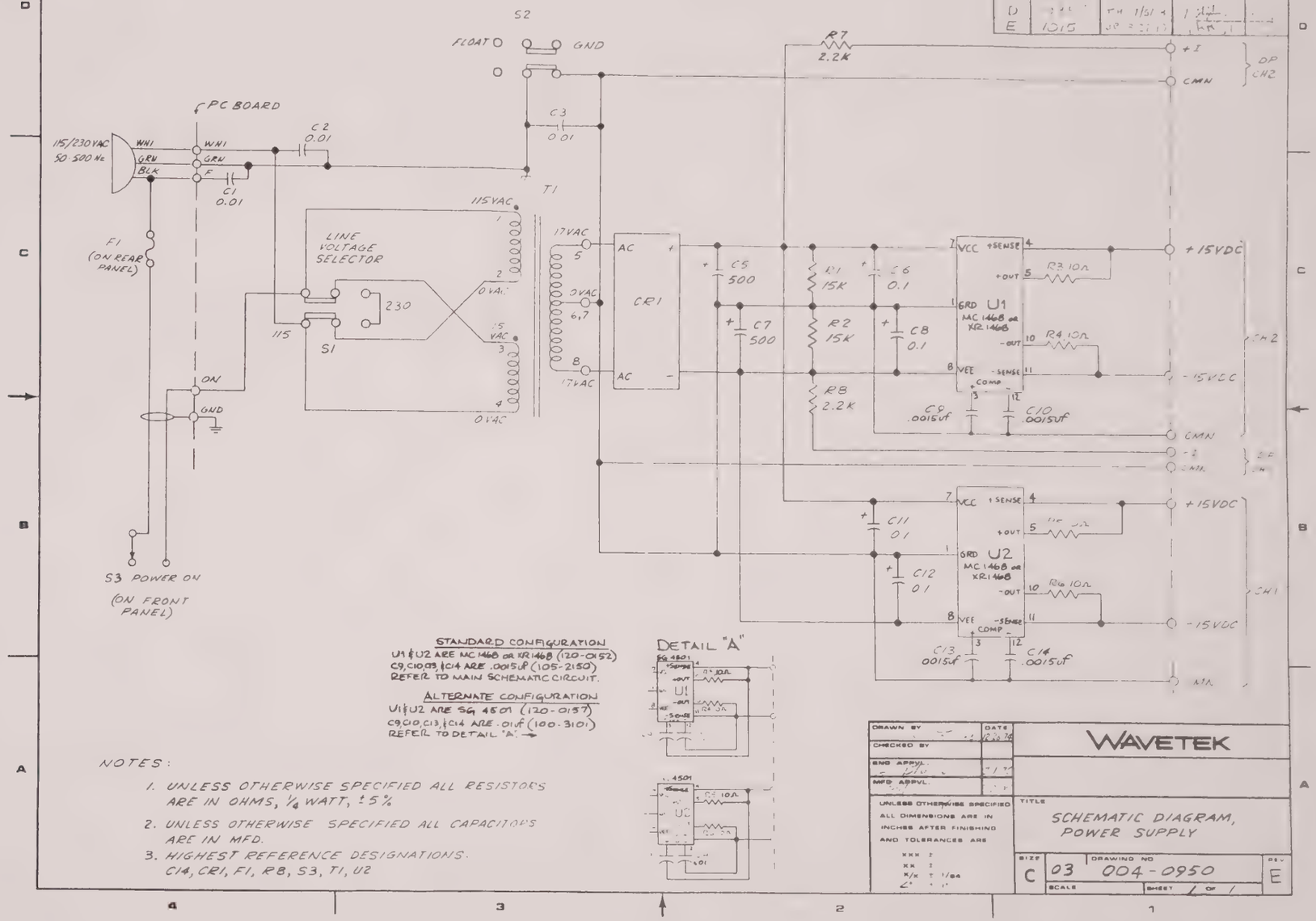

STANDARD CONFIGURATION
U1 & U2 ARE MC1468 OR XR1468 (120-0152)
C9, C10, C13, & C14 ARE .0015uF (105-2150)
REFER TO MAIN SCHEMATIC CIRCUIT.

ALTERNATE CONFIGURATION
U1 & U2 ARE SG 4501 (120-0157)
C9, C10, C13, & C14 ARE .01uF (100-3101)
REFER TO DETAIL "A" →

DETAIL "A"

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, ¼ WATT, ±5%
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITORS ARE IN MFD.
3. HIGHEST REFERENCE DESIGNATIONS: C14, CR1, F1, R8, S3, T1, U2

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ENG APPVL.	
MFG APPVL.	

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE
XXX ±
XX ±
X/X ± 1/64
∠° ± 1°

WAVETEK

TITLE: SCHEMATIC DIAGRAM, POWER SUPPLY

SIZE	DRAWING NO	REV
C	03 004-0950	E

SCALE | SHEET 1 OF 1

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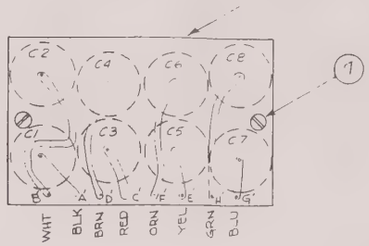
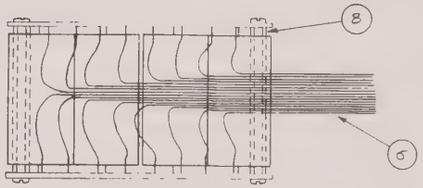
C	[illegible]			

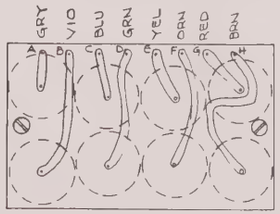
TOP VIEW



SIDE VIEW



BOTTOM VIEW



REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C1 C2 C3 C4 C5 C6 C7 C8	CAP, POLYCARB, 10UF 1% 100V	DA2B106F	IMB	104 6100	8
NONE	ASSY, CABLE 20 CONDUCTOR OPT 01 852-0940	852-2542	WVTK	1207-00-2542	1
1	ASSY, PC BD PREPPED 852-0940	852-2507	WVTK	1208-00-2507	1
7	M SCR: ST ZN SL 6-32X1/4 PH	2800-18-6104	WVTK	380 6042	4
NONE	M SCR: ST ZN PHIL 6-32X1/4			381 6042	4
8	SPR THD 1/4HX 6-32X2	1639	KEYST	389 2007	2

WAVETEK PARTS LIST

TITLE: MULTIPLIER ASSY 852-01

ASSEMBLY NO: 004 0940 REV: C

DRAWN BY		DATE
CHECKED BY		
ENG APPVL		
MFG APPVL		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE
XXX
XX
FRACTIONS
ANGLES

WAVETEK

TITLE: MULTIPLIER ASSEMBLY: 852 OPTION -01

SIZE	DRAWING NO	REV
C	004-0940	C

SCALE

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REV	ECO	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
D	LED RED. 2MCD@10. 40DVA	MV3054-1	MONSO	171 1600	2
3	BUFER KIT	2300-0832-01	WVTK	2300-0832-01	1
1	FRONT PANEL 852			300 0900	1
2	CONN COAX BLKHD RECPT 180L	31-010	AMPH	331 0006	4
4	CLIP LED MTG BLK (PV)	MP-32	MOMBO	362 2010	2

WAVETEK PARTS LIST

TITLE: PANEL ASSEMBLY FRONT 452/852

ASSEMBLY NO: 001 0900

REV: D

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE
MATERIAL	CHECKED	
	PROJ ENGR	
	RELEASE APPROVL	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX	
DO NOT SCALE DRAWING		

WAVETEK SAN DIEGO, CA

TITLE: PARTS LIST FRONT PANEL

SIZE	FSCM NO	DWG NO	REV
D	23338	001 0900	D

SCALE | MODEL 452/852 | SHEET 1 OF 1

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REV	ECO	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
1	PANEL ASSEMBLY FRONT 452/852			001 0900	1
2	PANEL ASSY REAR			002 0983	1
3	MAINBOARD ASSY 852			004 0930	2
4	MULTIPLIER ASSY 852-01			004 0940	2
29	CAP FI VAL DP MICA 100PF 5% 0 TO +70PPM/C 300V	CM03FD101J03	CDE	101 1100	4
30	RES.CFLM. 1.0K OHM 5% 1/4W	CF-071K-5%	DALE	116 2101	2
15	LABEL.SERIAL NUMBER/FILTERS & SYNTHESIZERS	FBB-8660	WVTK	1400-01-8660	1
12	BRACKET. ANGLE. MODIFIED	1400-02-2400	WVTK	1400-02-2400	4
14	SHIELD. MYLAR	1400-02-3540	WVTK	1400-02-3540	2
NONE	SUPER KIT	2500-8521-04	WVTK	2500-8521-04	1
26	TY-WRAP	TY-523M	TB	2800-00-0006	2
NONE	SCREW.6-32X1/2 FH 100 PHLP.Z	6-32 X 1/2 F.H 100	CMRCL	2800-44-6108	4

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	SUB ASSY 852-01 ANALOG FILTER	002 0901	C
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
19	KNOB WHT BAR 0-10/30 852 W/MP	05-370 0755	WVTK	370 0755	6
18	KNOB WHT BAR MULT 852 W/MP	05-370 0756	WVTK	370 0756	2
16	TIE CABLE NYL NAT (CLAMP)	PLC1M-84-M	PANDJ	377 4002	4
27	WIRE 824 AWG BON BLACK	1524	BELCO	378 1701	3
NONE	SLVNG PLASTIC FBRGLS #14AWG	PIF130-14	BELCO	378 3141	1
28	SLVNG PLASTIC FBRGLS #18AWG	PIF130-18	ALPHA	378 5181	4
NONE	M SCR BT IN SL 6-32X1/4 PH	2800-18-6104	WVTK	380 6042	4
33	M SCR BT IN 4-40 X 3/8 PH	2800-23-4106	WVTK	381 4062	12
34	M SCR BT IN PHIL 6-32X1/4			381 6042	14
36	M SCR BT IN PH 6-32X3/4 PH			383 6123	6
37	NUT HX BT IN 6-32X1/4 AV			387 6080	6

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	SUB ASSY 852-01 ANALOG FILTER	002 0901	C
		PAGE 3	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
5	SIDE FRAME	MP40375	BURKEY	303 0500	2
7	TRIM FRONT SHORT	MP40282-1	BURKEY	303 0901	1
8	TRIM REAR	MP40281-1	BURKEY	303 0902	1
9	SUPPORT BAR MAINBDS (452/852)			303 0908	3
6	TRIM FRONT TOP SUPR/SNUB 512	MP40318-4	BURKEY	307 0914	2
10	PC SHIELD (452/852)			320 0970	1
11	S TOG SPDT ON-ON RB	7101-BYZQ	C&K	340 1201	1
NONE	SOCKET CRIMP FEMALE 09310	42827-2	AMP	353 0106	6
24	LUG SOLDER ANGLED #6	1416-6	SMITH	359 0006	1
25	LUG SOLDER FLAT 1/4 IN	762-264	ZIER	359 0008	1
21	CLIP COMP MTG .375 I 1.125	6001-12A	AUGAT	362 2001	1
22	CLIP COMP MTG .475 I 1.125	6003-8A	AUGAT	362 2002	1
20	KNOB PBH BUTTON BLK (452/852)	8303	CRL	370 0718	6

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	SUB ASSY 852-01 ANALOG FILTER	002 0901	C
		PAGE 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
38	WASHER FLAT STL #6 .147ID .312OD .028THK			388 0060	6
NONE	WASHER EXT LK STL ZN #6			388 1061	3
17	WASHER FLT NYL .141ID .312OD SHOULDER WASHER	SW8S-2501	MICRO	388 4251	8
23	SPR AL 19300 #6 3/8 L	407	KEYST	389 2011	6
13	BKT ANG BT 24 .628 X	618	KEYST	389 3004	2
32	RIVET STL WI .123DX 136L PH			389 8001	3
31	SPADE BOLT 6-32 X 7/8 3/8THD	1259	KEYST	389 9001	3
NONE	ADHESIVE PASTE CLEAR (RTV)	RTV108	GE	500 2001	10
44	TAPE	P-256-1/2"	PRMCL	5600-05-0010	14

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	SUB ASSY 852-01 ANALOG FILTER	002 0901	C
		PAGE 4	

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK
MATERIAL	CHECKED		TITLE: PARTS LIST SUBASSEMBLY
FINISH WAVETEK PROCESS	PROJ. ENGR		
DO NOT SCALE DRAWING	RELEASE APPROVAL		SIZE D · FSCM NO 23338 · DWG NO 002 0901 · REV C
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX		SCALE · MODEL 852 · SHEET 1 OF 4

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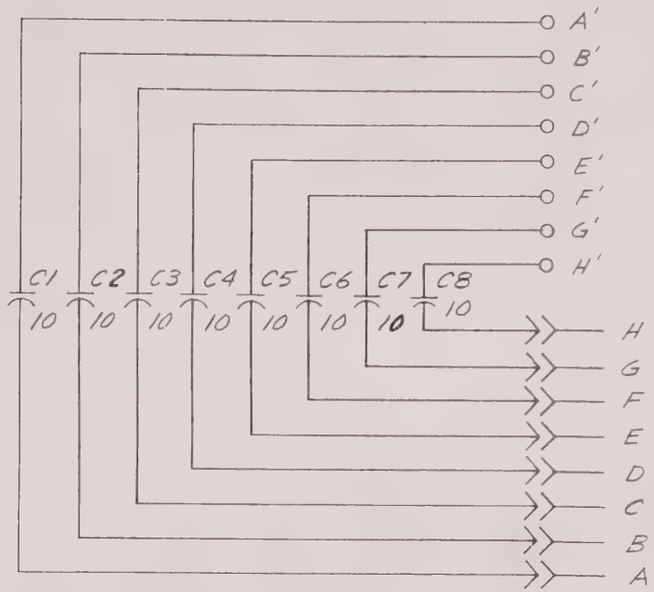
LTR	ECO NO.	CHANGED BY	APPV'D BY	DATE
A	RELEASED			



NOTE: CAPS IN MICROFARADS ±1%

DRAWN BY	DATE	WAVETEK
CHECKED BY		
ENG APPVL	4/20/15	
MFG APPVL	4/5/13	

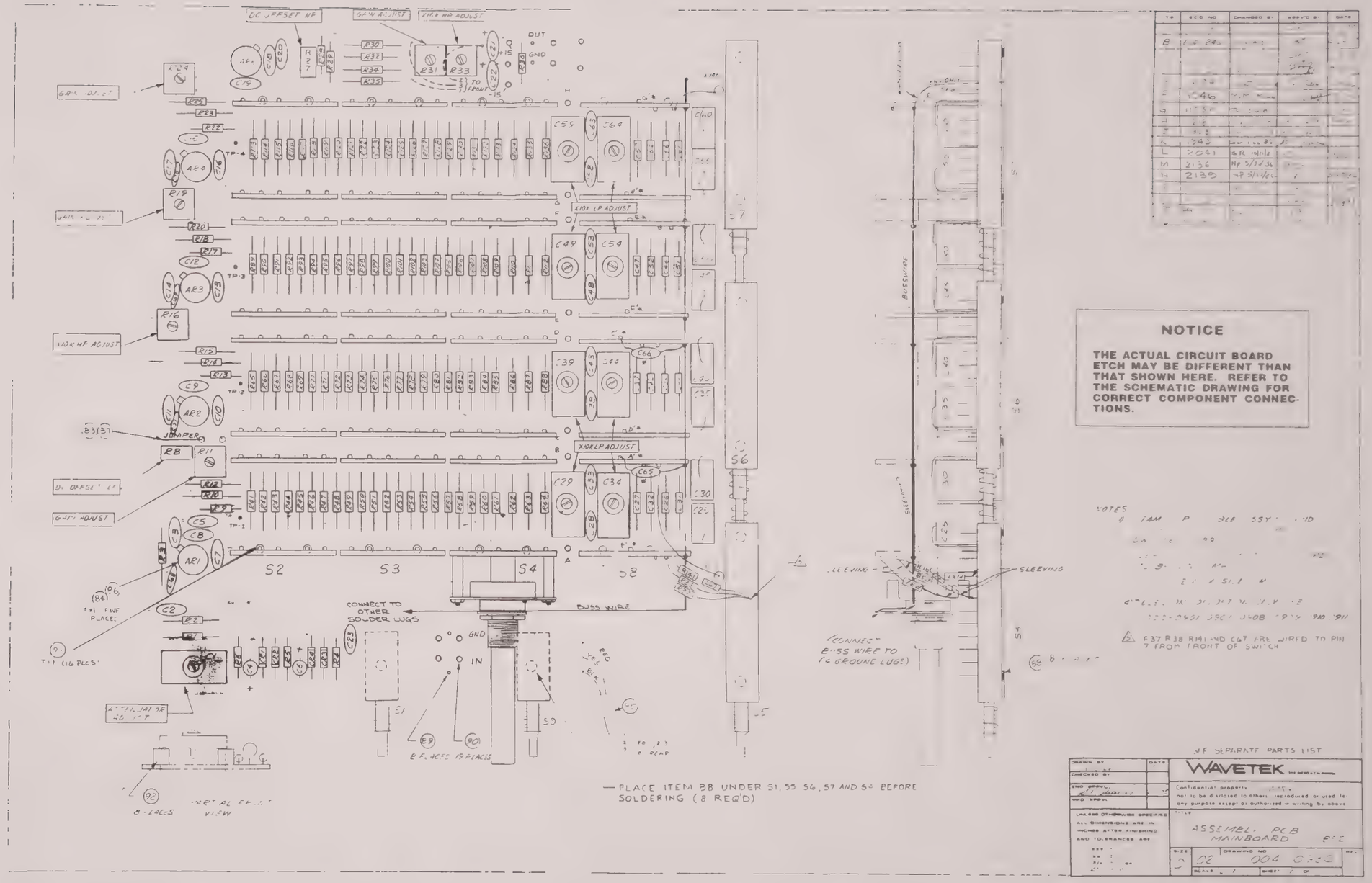
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE

.XXX ±
.XX ±
X/x ± 1/64
∠° ± 1°

TITLE: MULTIPLIER ASSEMBLY: 852 OPTION -01

SIZE	DRAWING NO	REV
B	03 004-0940	A
	SCALE ~	SHEET 1 OF 1

SIZE B | DWG NO 03-004-0940 | REV A



TR	ECO NO	CHANGED BY	APPD BY	DATE
B	1046			
E	1046			
G	1134			
K	1243			
L	1241			
M	2136			
N	2139			

NOTICE

THE ACTUAL CIRCUIT BOARD ETCH MAY BE DIFFERENT THAN THAT SHOWN HERE. REFER TO THE SCHEMATIC DRAWING FOR CORRECT COMPONENT CONNECTIONS.

NOTES

△ F37 R38 RM1 AND C67 ARE WIRED TO PIN 7 FROM FRONT OF SWITCH

— PLACE ITEM 28 UNDER S1, S5 S6, S7 AND S8 BEFORE SOLDERING (8 REQ'D)

NF SEPARATE PARTS LIST

DRAWN BY	DATE	WAVETEK
CHECKED BY		
ENG APPVL		Confidential property of ... not to be disclosed to others, reproduced or used for any purpose except as authorized in writing by above
MFG APPVL		
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE .xxx ± .xx ± .x ± 1/64 ∠ ± 1°		TITLE: ASSEMBL. PCB MAINBOARD PCB
		SIZE D; DRAWING NO 02 904 0[illegible]; REV
		SCALE 1/1; SHEET 1 OF

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REV	BY	DATE	APP
B			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR PART NO	MFGR	WAVETEK NO	QTY/PT
NONE	ELECT SCHEMATIC PC ASSY. MAINBOARD (852)	03 004 0930	WVTK	03 004 0930	1
C67	CAP CER 1000PF +80 20% 1KV	838 056 75U 1027	TUSON	100 2100	1
C27 C37 C47 C57	CAP POLYSTY-EPOXY CASE, A/L 0 01UFD 1% 100V	13RB103F	S&EI	104 3104	4
C1	CAP VAR MICA 2 25PF 175V	421	ARCO	108 0250	1
R137	RES.CFLM 330 OHM 5% 1/4W	CF1/4 330OHM 5%	STKPL	116 1331	1
R141	RES CFLM 2.7K OHM 5% 1/4W	CF 1/4 2.7K OHM 5%	STKPL	116 2271	1
R140	RES CFLM 3.9K OHM 5% 1/4W	CF 1/4 3.9K OHM 5%	STKPL	116 2391	1
R30	RES CFLM 4.7K OHM 5% 1/4W	R25JE4.7K	ROHM	116 2471	1
R37	RES.CFLM 5.6K OHM 5% 1/4W	CF 1/4 5.6K 5%	STKPL	116 2561	1
AR2 AR3 AR4 AR5	U LIN OP AMP FET IN LH0062CH	LH0062CH	NSC	120 1007	4
AR1	U LIN OP AMP ELF 356	LF356H	NSC	120 1014	1

WAVETEK PARTS LIST — TITLE: MAINBOARD ASSY 852 — ASSEMBLY NO: 004 0930 — REV: U — PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR PART NO	MFGR	WAVETEK NO	QTY/PT
NONE	ASSY. PRE WAVE LOAD 852-0930	852-2540	WVTK	1208-00 2540	1
S1 S9	S PSH/PSH DPDT	341 2202	WVTK	341 2201	2
S5 S6 S7	S PSH/PSH 8 POLE 2 POS	PB1 8	CRL	341 8200	3
S8	S ROT 12P 3POS (852 REAR)	7529480[illegible]	LEDEX	344 3050	1
B8	SPACER SWITCH NYLON 1/16 IN	FW4 062	MICRO	349 2010	8
91	LUG SOLDER FLAT 3/8 IN	761 375	ZIER	359 0005	4
92	SPCR NY 1/4D X 3/16L/ 1711D	135P038	MICRO	376 2105	2
93	SPCR NY 1/8D X 1/4L/ 0631D	901801501	MICRO	376 2106	4
94	WIRE BUSS TINNED #18 AWG	W18B	WEICO	378 0400	10
87	WIRE BUSS HD DMN TND #22 AWG	W22D	WEICO	378 0600	1
95	CABLE TWIJ COND RED/YEL/BLK	3154	ALPHA	370 4004	10

WAVETEK PARTS LIST — TITLE: MAINBOARD ASSY 852 — ASSEMBLY NO: 004 0930 — REV: U — PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR PART NO	MFGR	WAVETEK NO	QTY/PT
96	SLVNG PLASTIC FIBRGLS #18AWG	PTF130 18	ALPHA	378 5181	1.2
80	SLVNG TEFLON #22AWG	TFT 250 22	ALPHA	378 5220	.02

WAVETEK PARTS LIST — TITLE: MAINBOARD ASSY 852 — ASSEMBLY NO: 004 0930 — REV: U — PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR PART NO	MFGR	WAVETEK NO	QTY/PT
C10 C12 C13 C15 C16 C18 C19 C3 C5 C7 C9	CAP MONO 0.01UF+/-20% 50V 0 2% S	SR215E103AT	AVI	100 3105	11
C68 C69 C70	CAP MICA FI VAL DIP 10PF 5% 200PPM/C 500V	CM05CD150J03	CDE	101 0100	3
C71	CAP MICA FI VAL DIP 15PF 5% 200 PPM/C 500V	CM05CD150J03	CDE	101 0150	1
C20 C23	CAP MICA FI VAL DIP 22PF 5% 20+100PPM/C 500V	CM05ED220J03	CDE	101 0220	2
C17	CAP MICA FI VAL DIP 47PF 5% 20+100PPM/C 500V	CM05ED470J03	CDE	101 0470	1
C14 C2	CAP FI VAL DP MICA 100PF 5% 0 TO +70PPM/C 500V	CM05FD101J03	CDE	101 1100	2
C11	CAP MICA FI VAL DIP 500PF 5% 0 TO+70PPM/C 500V	CD15FD[illegible]1J03	CDE	101 1500	1
C28 C33 C38 C43 C48 C53 C58 C63	CAP MICA FI VAL DIP 820PF 5% 0 TO+70PPM/C 300V	CD15FC121J03	CDE	101 1820	8
C32 C42 C52 C62	CAP POLYSTY-EPOXY CASE, A/L 0 01UFD	13RB103	S&EI	104 3104	4
C26 C31 C36 C41 C46 C51 C56 C61	CAP POLYCARB 1UF 1% 100V	C31B105F	BISHO	104 4100	8
C29 C34 C39 C44 C49 C54 C59 C64	CAP VAR MICA 24 200PF 175V	STO425	ARCO	108 1200	8
C21 C22 C4 C6	CAP TANT. 1 0UF 20% 35V	T368A1 5M035AS	KEMET	109 5100	4
R18	RES MFLM 320 OHM 5% 1/10W T2	RN55C3[illegible]80D	ENOI	110 3281	1
R10	RES MFLM 453 OHM 1% 1/8W T0	RN55C4530F	UMCEM	110 4530	1
R23	RES.MFLM 887 OHM 1% 1/8W T0	RN55C8870F	UMCEM	110 8870	1
R12 R20 R25 R32	RES MFLM 1.00K 1% 1/10W T2	RN55C1001F	UMCEM	111 1001	4
R34	RES MFLM 1.33K 1% 1/8W T0	RN55C1331F	KADAN	111 1330	1
R15 R35	RES MFLM 1.50K 1% 1/10W T2	5063JD1K500F	MEPCO	111 1501	2
R30	RES MFLM 1.62K 1% 1/8W T0	RN55C1621F	UMCEM	111 1620	1
R113 R117 R41 R45 R65 R69 R89 R93	RES MFLM 1.99K 1% 1/8W T0	CR125 100PPM	CTLRE	111 1990	8
R116 R120 R44 R48 R68 R72 R92 R96	RES MFLM 3.98K 1% 1/8W T0	CR125 100PPM	CTLRE	111 3980	8
R114 R118 R42 R46 R66 R70 R90 R94	RES MFLM 7.96K 1% 1/8W T0	CR125 100PPM	CTLRE	111 7960	8
R115 R119 R43 R47 R67 R71 R91 R95	RES FI MFLM 15.9K 1% 1/8W T0	CR125 100PPM	CTLRE	112 1590	8
R101 R121 R125 R49 R53 R73 R77 R97	RES MFLM 19.9K 1% 1/8W T0	CR125 100PPM	CTLRE	112 1990	8
R100 R104 R124 R128 R52 R56 R76 R80	RES MFLM 39.8K 1% 1/8W T0	CR125 100PPM	CTLRE	112 3980	8
R102 R122 R126 R50 R54 R74 R78 R98	RES MFLM 79.6K 1% 1/8W T0	CR125 100PPM	CTLRE	112 7960	8
R2 R3	RES MFLM 100K 1% 1/10W T2	RN55C1003F	UMCEM	113 1001	2
R103 R123 R127 R51 R55 R75 R79 R99	RES MFLM 159K 1% 1/8W T0	CR125 100PPM	CTLRE	113 1590	8
R105 R109 R129 R133 R57 R61 R81 R85	RES MFLM 199K 1% 1/8W T0	CR125 100PPM	CTLRE	113 1990	8
R26	RES MFLM 200K 1% 1/10W T2	RN55C2003F	UMCEM	113 2001	1
R108 R112 R132 R136 R60 R64	RES. MFLM 398K 1% 1/8W	CR125 100PPM	CTLRE	113 3980	8

WAVETEK PARTS LIST — TITLE: ASSY PRE WAVE LOAD 852-0930 — ASSEMBLY NO: 1208-00-2540 — REV: B — PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR PART NO	MFGR	WAVETEK NO	QTY/PT
R84 R88	TO				
R106 R110 R130 R134 R58 R62 R82 R86	RES. VAL CERMET 796R 1% 100PPM/C RN60 SIZE	RN60 796R 1% 100PPM	HYMEG	113 7960	8
R1	RES MFLM 900K 1% 1/10W T2	R25D	CTLRE	113 9009	1
R107 R111 R131 R135 R59 R63 R83 R87	RES MFLM 1.58M 1% 1/8W T0	MAX 1.58MFP	HYMEG	114 1590	8
R36	RES CFLM 47 OHM 5% 1/4W	CF 1/4 47 OHM 5%	STKPL	116 0471	1
R13 R17 R22 R29 R9	RES CFLM 100 OHM 5% 1/4W	CF 1/4 100 OHM 5%	STKPL	116 1101	5
R4	RES CFLM 4.7K OHM 5% 1/4W	R25JE4.7K	ROHM	116 2471	1
R5 R6	RES CFLM 10K OHM 5% 1/4W	CF 1/4 10K OHM 5%	STKPL	116 3101	2
R11 R19 R24 R31	RES VAR CMT 50 OHM 1/8W FM	72PR50	BECK	118 0500	4
R16	RES VAR CMT 1.0K 1/8W FM	72PR1K	BECK	118 2102	1
R33	RES VAR CMT 10K 1/8W FM	72PR10K	BECK	118 3101	1
R8	RES VAR CMT 50K	72PR50K	BECK	118 3501	1

WAVETEK PARTS LIST — TITLE: ASSY PRE WAVE LOAD 852-0930 — ASSEMBLY NO: 1208-00-2540 — REV: B — PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR PART NO	MFGR	WAVETEK NO	QTY/PT
	1/8W FM 20T				
R27	RES VAR CMT 200K 1/8W FM 20T	72PR200K	BECK	118 4203	1
R14	RES.MFLM 57.6 OHM 1% 1/8W T0	RN55C57R6F	UMCEM	119 5760	1
NONE	ASSY. PC BD PREPPED 852-0930	852-254.	WVTK	1208-00-2541	1
CR1 CR4	SL IR 6.8V 5% 400MW (1N754A)	1N754A	MOT	131 9680	2
CR2 CR3	SL LW LK 70PIV 200MW (1N457)	1N457A	FAIR	132 0457	2
NONE	CAP.POLYC, IMF, 100V AXIAL	B1A105F	ELPAC	1500-41 0504	8
S2 S3 S4	S ROT 8P 12 POS (852 CUTOFF)	7529470[illegible]	LEDEX	345 8124	3
86	SOCKET I C TO-5	8056-22[illegible]	AUGAT	350 0801	15
89	CONN TERM PIN .025 SW (26 NO)	W239-025-5000	A/S	354 0007	18
92	SPCR NY 1/4D X 3/16L/ 1711D	135P038	MICRO	376 2105	16
93	SPCR NY 1/8D X 1/4L/ 0631D	901801501	MICRO	376 2106	12

WAVETEK PARTS LIST — TITLE: ASSY PRE WAVE LOAD 852-0930 — ASSEMBLY NO: 1208-00-2540 — REV: B — PAGE 3

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK
MATERIAL	CHECKED		TITLE: PARTS LIST MAINBOARD
	PROJECTION		
FINISH: WAVETEK PROCESS	RELEASE APPROV		
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX .XXX		SIZE: D — FSCM NO: 23338 — DWG NO: [illegible] — REV
DO NOT SCALE DRAWING			SCALE — MODEL: 852 — SHEET 1 OF 1

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REV	ECO	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
1	PANEL ASSEMBLY FRONT 452/852			001 0900	1
2	PANEL ASSY REAR			002 0985	1
3	MAINBOARD ASSY 852			004 0930	2
11	LABEL, SERIAL NUMBER/FILTER8 & [illegible]	FSB-8660	WVTK	1400-01-8660	1
41	SUPER KIT	2500-0852-03	WVTK	2500-0852-03	1
31	LOCKWASHER, INTERNAL STAR, PLATED, #6	#6 LOCKWASHER	CMRCL	2800-24-6000	3
4	SIDE FRAME	MP40375	BUKEY	303 0900	2
6	TRIM FRONT SHORT	MP40282-1	BUKEY	303 0901	2
7	TRIM REAR	MP40281-1	BUKEY	303 0902	2
8	SUPPORT BAR MAINBDU (452/852)			303 0908	3
5	TRIM FRONT TOP SUPR/SNUB 312	MP40318-4	BUKEY	307 0914	2
9	PC SHIELD (452/852)			320 0970	1
10	S TDQ SPDT ON-ON R8	7101-SYZQ	C&K	340 1201	1
20	LUG SOLDER ANGLED #6	1416-6	SMITH	359 0006	1

WAVETEK PARTS LIST | TITLE: SUBASSY 852 ANALOG FILTER | ASSEMBLY NO: 002 0900 | REV: H | PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
21	LUG SOLDER FLAT 1/4 IN	762-264	ZIER	359 0008	1
17	CLIP COMP MTG .375 X 1.125	6001-12A	AUGAT	362 2001	1
18	CLIP COMP MTG .475 X 1.125	6003-8A	AUGAT	362 2002	1
13	KNOB DIAL-BAR 0-10 LTGRY/WHT	05-370 0775	WVTK	370 0775	6
14	KNOB MULT 1-10K LT-GRY/WHT-MK	05-370 0776	WVTK	370 0776	2
16	KNOB PUSH BUTTON GRAY (452/852)	[illegible]	CRL	370 0778	6
12	TIE CABLE NY MAT (CLAMP)	PLC1M-64-M	PANDT	377 4002	4
NONE	WIRE #24 AWG BON BLACK	1524	WEICO	378 1705	22.75
37	WIRE #24 AWG BON YELLOW	1524	WEICO	378 1745	6
36	WIRE #24 AWG BON GREEN	1524	WEICO	378 1735	6
38	WIRE #24 AWG BON BLUE	1524	WEICO	378 1765	3

WAVETEK PARTS LIST | TITLE: SUBASSY 852 ANALOG FILTER | ASSEMBLY NO: 002 0900 | REV: H | PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
39	WIRE #24 AWG BON VIOLET	1524	WEICO	378 1775	3
23	SLVNG PLASTIC FIBROUS #18AWG	FIF130-18	ALPHA	378 3181	1.65
NONE	SHRINK TBG PLYFIN BLACK 3/32 IN	130830	3M	378 5515	3
32	SHRINK TBG PLYFIN BLACK 1/4 IN	FIT-105-1/4	ALPHA	378 5540	1.5
26	M SCR ST ZN 4-40 X 3/8 PH	2800-23-4106	WVTK	381 4062	12
27	M SCR ST ZN PHIL 6-32X1/4			381 6042	18
28	M SCR ST ZN PH 6-32X3/4 BH			383 6121	6
34	PHL NUT, N/P BRASS 1/4-36X5/16AF	1/4-36X5/16AF PHLNUT B	CMRCL	387 0143	1
29	NUT HX ST ZN 6-32X1/4 AF			387 6080	6
30	WASHER FLA STL #6 .147ID .312OD .028THK			388 0060	6
13	WASHER PLT NAL 1/4ID .312OD SHOULDER	SWSS 2501	MICRO	388 4251	8

WAVETEK PARTS LIST | TITLE: SUBASSY 852 ANALOG FILTER | ASSEMBLY NO: 002 0900 | REV: H | PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
	WASHER				
19	SPR AL .153OD #6 3/8 L	407	KEYST	389 2011	6
25	RIVET BTL NI .123DX .156L PH			389 8001	3
24	SPADE BOLT 6-32 X 7/8 3/8THD	1259	KEYST	389 9001	3
35	TAPE	P-236-1/2"	PRMCL	3600-05-0010	24

WAVETEK PARTS LIST | TITLE: SUBASSY 852 ANALOG FILTER | ASSEMBLY NO: 002 0900 | REV: H | PAGE 4

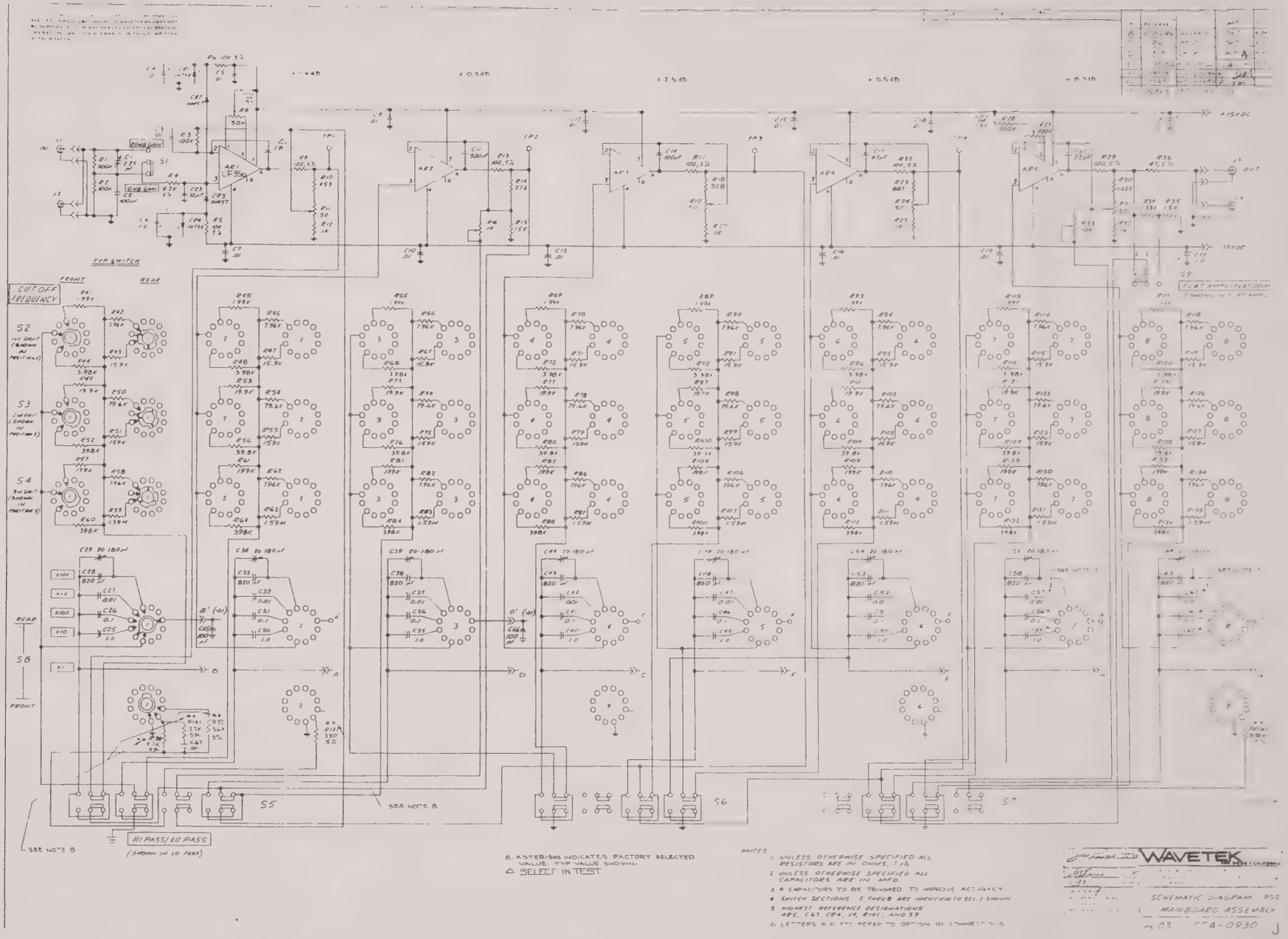
NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES | MATERIAL | FINISH WAVETEK PROCESS | DO NOT SCALE DRAWING | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX

WAVETEK

TITLE: PARTS LIST SUBASSEMBLY

SIZE: D | FSCM NO: 23338 | DWG NO: 002 0900 | REV: H | SCALE | MODEL: 852 | SHEET 1 OF 1

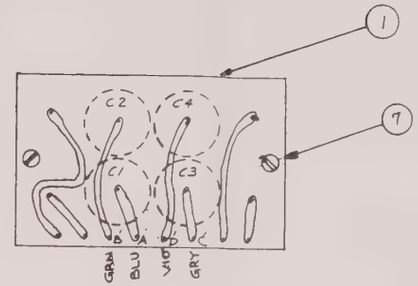


8. ASTERISKS INDICATES FACTORY SELECTED VALUE. TYP VALUE SHOWN.
△ SELECT IN TEST

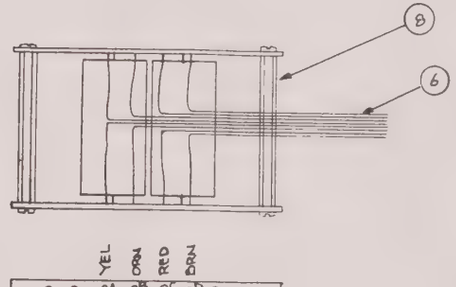
NOTES
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, ±1%
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITORS ARE IN MFD.
3. ⊕ CAPACITORS TO BE TRIMMED TO IMPROVE ACCURACY.
4. SWITCH SECTIONS 2 THRU 8 ARE IDENTICAL TO SEC. 1 SHOWN
5. HIGHEST REFERENCE DESIGNATIONS ARE, C67, CR4, J4, R181, AND S9
6. LETTERS A & F ARE REFERENCED TO OPTION 01 CONNECTORS

WAVETEK
SCHEMATIC DIAGRAM 852
MAINBOARD ASSEMBLY
A3 CCA-0930 J

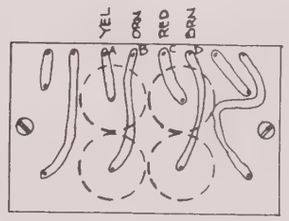
TOP VIEW



SIDE VIEW



BOTTOM VIEW



REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	CAP, POLYCARB, 10UF 1% 100V	DA2B106F	IMB	104 6100	4
NONE	ASSY, PC BD PREPPED 452-01-0980	452-01-2711	WVTK	1208-00-2711	1
NONE	CABLE: RIBBON 10 COND	3540-7	ALPHA	378 4002	17
NONE	M SCR: ST ZN SL 6-32X1/4 PH	2800-18-6104	WVTK	380 6042	4
NONE	SPR: THD 1/4HX 6-32X2	1639	KEYST	389.2007	2

WAVETEK PARTS LIST	TITLE MULTIPLIER ASSY 452-01	ASSEMBLY NO 004 0980	REV A

PAGE 1

WAVETEK

TITLE
MULTIPLIER ASSEMBLY:
452 OPTION -01

DWG NO 02 004-0980 REV B

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REV		BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	SUBASSY 852 ANALOG FILTER			002 0900	1
NONE	BOTTOM COVER ASSY BLACK			002 3092	1
NONE	COVER TOP BLACK	MPV-40464-14	BURLEY	303 0101	1
NONE	M SCR ST ZM PHIL 6-32X1/4			381 6042	4
NONE	INST MANUAL 452/852 1ST ED			800 0091	1 3

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	DUAL CHANNEL 852	000 0900	B
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	SUB ASSY 852-01 ANALOG FILTER			002 0901	1
NONE	BOTTOM COVER ASSY BLACK			002 3092	1
R38	RES.CFLM. 1 OK OHM 5% 1/4W	CF-071K-5%	DALE	116 2101	1
NONE	COVER TOP. BLACK	MPV-40464-14	BURLEY	303 0101	1
NONE	M SCR ST ZM PHIL 6-32X1/4			381 6042	4
NONE	INST MANUAL 452/852 1ST ED			800 0091	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	DUAL CHANNEL 852 W/RANGE EXT OPTION 001	000 0901	E
		PAGE 1	

NOTE: UNLESS OTHERWISE SPECIFIED

WAVETEK SAN DIEGO, CALIFORNIA

TITLE	MODEL NO	DWG NO	REV
PARTS LIST TOP ASSEMBLY	852	000 0900	B
	MODEL NO	DWG NO	REV
	852-001	000 0901	E
	FSCM NO 23338	SHEET 1 OF 1	

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REV	ECC	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	FRONT PANEL 452	001 0950		001 0950	1
NONE	PANEL ASSY REAR			002 0983	1
NONE	MAINBOARD ASSY 452			004 0960	2
NONE	MULTIPLIER ASSY 452-01			004 0980	2
NONE	CAP FI VAL.DP MICA 100PF 5% 0 TO +70PPM/C 300V	CM05FD101J03	CDE	101 1100	4
NONE	BRACKET, ANGLE, MODIFIED	1400-02-2400	WVTK	1400-02-2400	4
NONE	SHIELD, MYLAR	1400-02-3340	WVTK	1400-02-3340	2
NONE	SUPER KIT	2300-0452-03	WVTK	2300-0452-03	1
NONE	TY-WRAP	TY-523M	TB	2800-00-0006	3
NONE	SCREW.6-32X1/2 FH 100 PHLP.2	6-32 X 1/2 F H 100	CMRCL	2800-44-6108	4
NONE	SIDE FRAME	MP40373	BUKEY	303 0300	2
NONE	TRIM FRONT SHORT	MP40282-1	BUKEY	303 0901	2
NONE	TRIM REAR	MP40281-1	BUKEY	303 0902	2
NONE	SUPPORT BAR MAINBDS (452/852)			303 0908	2

WAVETEK PARTS LIST | TITLE: SUBASSY 452-01 ANALOG FILTER | ASSEMBLY NO. 002 0951 | REV C | PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	WIRE 824 AWG 300 BLACK	1524	BELCO	378 1705	3
NONE	BLVNG PLASTIC FBRGLS 814AWG	PIF130-14	BELCO	378 5141	1
NONE	BLVNG PLASTIC FBRGLS 818AWG	PIF130-18	ALPHA	378 5181	4
NONE	M SCR ST ZN BL 4-40X3/8 PH	2800 38-4106	WVTK	380 4062	4
NONE	M SCR ST ZN 4-40 X 3/8 PH	2800-23-4106	WVTK	381 4062	8
NONE	M SCR ST ZN PHIL 6-32X1/4			381 6042	14
NONE	M SCR ST ZN PH 6-32X3/4 BH			383 6121	4
NONE	NUT HX ST ZN 6 32X1/4 AF			387 6080	4
NONE	WASHER FLAT STL #6 1471D 3120D 020THK			388 0660	4
NONE	WASHER EXT LK STL ZN #6			388 1061	2
NONE	WASHER PLT NUL 1/41D 3120D SHOULDER	SWSS-250	MICRO	388 4251	8

WAVETEK PARTS LIST | TITLE: SUBASSY 452-01 ANALOG FILTER | ASSEMBLY NO. 002 0951 | REV C | PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	TRIM FRONT TOP SUPR/SNUB 312	MP40318-4	BUKEY	307 0914	2
NONE	PC SHIELD (452/852)			320 0970	1
NONE	S TOG SPDT ON-ON RB	7101-SYZQ	C&K	340 1201	1
NONE	SOCKET CRIMP FEMALE .093ID	42827-2	AMP	353 0106	8
NONE	LUG SOLDER ANGLED #6	1416-6	SMITH	359 0006	1
NONE	LUG SOLDER FLAT 1/4 IN.	762-264	ZIER	359 0008	1
NONE	CLIP COMP MTG .375 X 1.125	6001-12A	AUGAT	362 2001	1
NONE	CLIP COMP MTG .475 X 1.125	6003-8A	AUGAT	362 2002	1
NONE	KNOB DIAL-BAR 0-10 LTGRY/WHT	03-370 0775	WVTK	370 0775	6
NONE	KNOB MULT 1-10K LT-GRY/WHT-MK	03-370 0776	WVTK	370 0776	2
NONE	KNOB PUSH BUTTON GRAY (452/852)	8300	CRL	370 0778	6
NONE	TIE CABLE NY NAT (CLAMP)	PLCIM-S4-M	PANDT	377 4002	4

WAVETEK PARTS LIST | TITLE: SUBASSY 452-01 ANALOG FILTER | ASSEMBLY NO 002 0951 | REV C | PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	WASHER SPR AL 1930D #6 3/8 L	407	KEYST	389 2011	4
NONE	BRT ANC ST IN 628 X 628	618	KEYST	389 3004	2
NONE	RIVET STL NI 123DX 136L PH			389 8001	2
NONE	SPADE BOLT 6-32 X 7/8 3/8THD	1259	KEYST	389 9001	2
NONE	TAPE	P-256-1/2"	PRMCL	3600-05-0010	14

WAVETEK PARTS LIST | TITLE: SUBASSY 452-01 ANALOG FILTER | ASSEMBLY NO 002 0951 | REV C | PAGE 4

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES | MATERIAL | FINISH WAVETEK PROCESS | DO NOT SCALE DRAWING | DRAWN | CHECKED | PROJ. ENGR | RELEASE APPROV | DATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX ±.XXX

WAVETEK

TITLE: PARTS LIST SUBASSEMBLY

SIZE	FSCM NO	DWG NO	REV
D	23338	002 0951	C

SCALE | MODEL 452-01 | SHEET 1 OF 1

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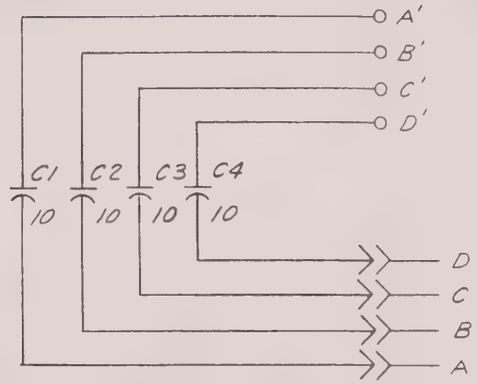
LTR	ECO NO	CHANGED BY	APPV'D BY	DATE
A	RELEASED			



NOTE: CAPS IN MICROFARADS, ±1%

DRAWN BY: [illegible]	DATE 4/25/75	WAVETEK
CHECKED BY:		
ENG APPVL: [illegible] Thanos	4/26/75	
MFG APPVL: Bill Rod. [illegible]	4/29/75	

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE .XXX ± .XX ± X/x ± 1/64 ∠° ± 1°

TITLE: MULTIPLIER ASSEMBLY: 452 OPTION -01

SIZE	DRAWING NO.	REV
B	03 004-0980	A
	SCALE ~ SHEET 1 OF 1	

SIZE B DWG NO 03-004-0980 REV A

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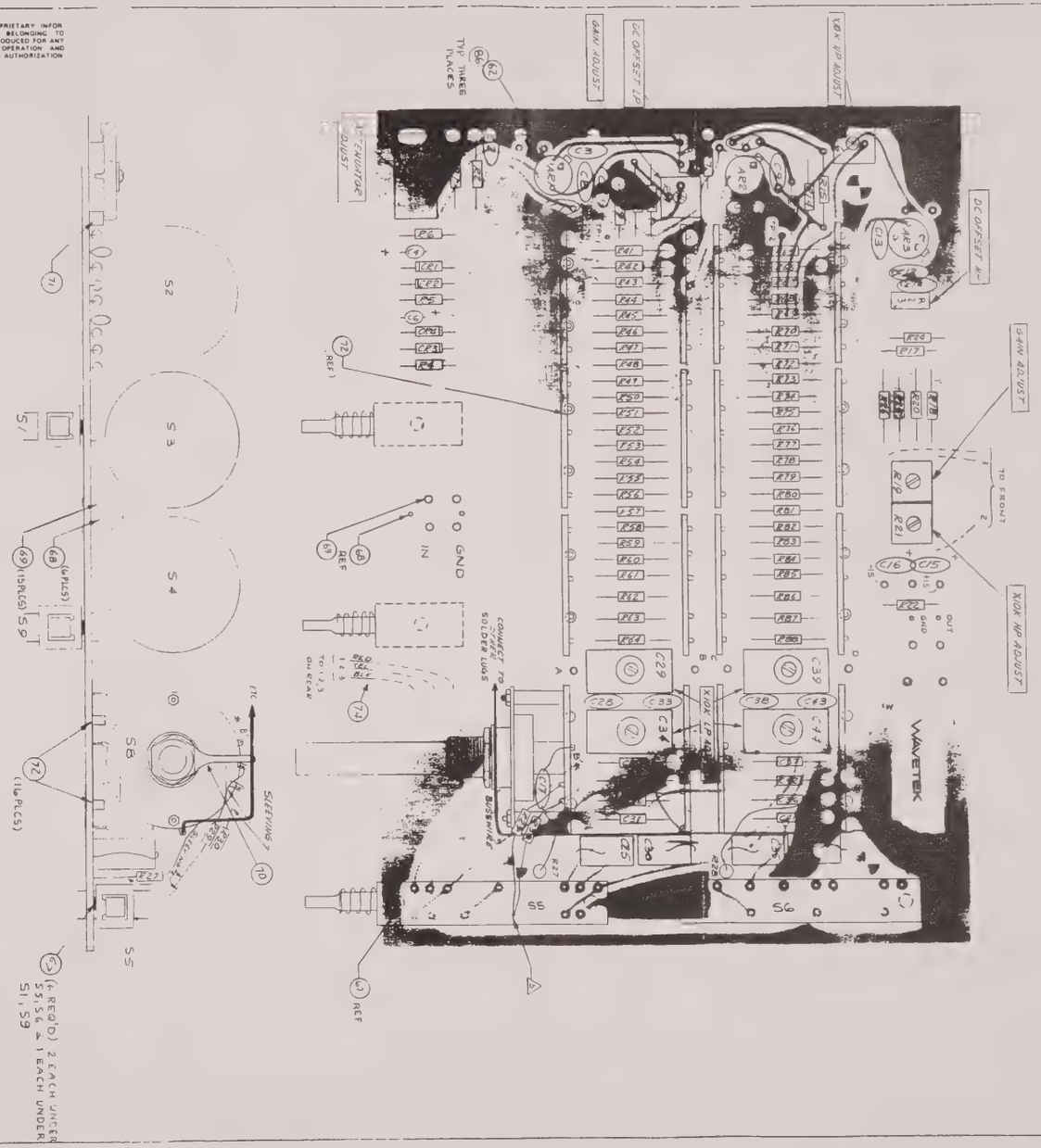

LTR	ECC NO	CHANGED BY	APP'D BY	DATE
D	[illegible]	[illegible]	[illegible]	[illegible]
J	[illegible]	[illegible]	[illegible]	[illegible]
K	[illegible]	[illegible]	[illegible]	[illegible]
L	[illegible]	[illegible]	[illegible]	[illegible]
M	19,5	[illegible]	[illegible]	[illegible]
N	1922	[illegible]	[illegible]	[illegible]
P	2[illegible]	[illegible]	[illegible]	[illegible]
R	2136	MP 5/12/86	[illegible]	[illegible]
S	2139	MP 5/27/86	[illegible]	5/27/86
T	-	-	-	-

NOTICE

THE ACTUAL CIRCUIT BOARD ETCH MAY BE DIFFERENT THAN THAT SHOWN HERE. REFER TO THE SCHEMATIC DRAWING FOR CORRECT COMPONENT CONNECTIONS.

NOTES:

1. [illegible] USEABLE REFERENCE DESIGNATORS SEE DWG No 00 995 [illegible]
2. PLATED PROPULSION TYPE BOARD TO BE .062 MAX
3. SHEETS 2-4, A SIZE (LAN
4. # USED ON OPTION ONLY SEE 000-095 000-0957 000-0958 000-0959 000-0960 000-0961
5. R30 AND R29 ARE WIRED TO PIN NO 7 FROM REAR OF BOARD

DRAWN BY	DATE	WAVETEK [illegible]
CHECKED BY		
ENG APPVL		
MFG APPVL		
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE .XXX ± .XX ± .0X ± 1/64 ∠ ± 1°		TITLE ASSEMBLY, PCB MAIN BOARD (452)
		SIZE D / DRAWING NO 02-004-0960 / REV - / SCALE 2/1

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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C27 C37	CAP.POLYSTY.EPOXY CASE.A/L 0 01UFD 1% 100V	PSBPC1103F	AMRAD	104 3104	2
C1	CAP.VAR MICA. 2-25PF 175V	421	ARCO	108 0230	1
R27	RES.CFLM. 1 0K OHM 5% 1/4W	CF-071K-5%	DALE	116 2101	1
R30	RES.CFLM 6 8K OHM 5% 1/4W	CF 1/4 6 8K OHM 5%	STKPL	116 2681	1
R28	RES.CFLM 33K OHM 5% 1/4W	CF 1/4 33K OHM 5%	STKPL	116 3331	1
R29	RES.CFLM 47K OHM 5% 1/4W	CF 1/4 47K OHM 5%	STKPL	116 3471	1
AR3	U LIN OP-AMP FET IN LH0062CH	LH0062CH	NSC	120 1007	1
AR1 AR2	U LIN OP-AMP (LF-356)	LF-356HC	TI	120 1014	2
NONE	SPK ASSY. PRE WAVE LOAD 432-0960	432-2709	WVTK	1208-00-2709	1
B1 B9	S PBH/PBH DPDT	PB-1	CRL	341 2201	2
B5 B6	S PBH/PBH 6 POLE 2 POS	PB1-B	CRL	341 6200	2

WAVETEK PARTS LIST — TITLE: MAINBOARD ASSY 432 — ASSEMBLY NO: 004 0960 — REV: T — PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
B8	S ROT 7P 3 POS (432 MULT)	732946001	LEDEX	343 7051	1
B2 B3 B4	S ROT 4P 12 POS (432 CUTOFF)	732943001	LEDEX	345 4120	3
67	SPACER SWITCH NYLON 1/16 IN	FW4-062	MICRO	349 2010	6
70	LUG SOLDER FLAT 3/8 IN	761-375	ZIER	359 0005	4
73	WIRE BUSS TINNED #18 AWG	W1818	WEICO	378 0400	12
74	CABLE T4 3 COND RED/YEL/BLK	3154	ALPHA	378 4004	3
75	SLVNG PLASTIC FBRGLS #18AWG	P1F130-18	ALPHA	378 5181	10

WAVETEK PARTS LIST — TITLE: MAINBOARD ASSY 432 — ASSEMBLY NO: 004 0960 — REV: T — PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C10 C12 C13 C3 C5 C7 C9	CAP-MONO 0 01UF+/-20% 50V.0 2L B	SR215E103ZAT	AVX	100 3105	7
C14	CAP MICA FX VAL DIP 47PF 5% -20+100PPM/C 300V	CM05ED470J03	CDE	101 0470	1
C2	CAP FX VAL.DP MICA 100PF 5% 0 TO +70PPM/C 300V	CM05FD101J03	CDE	101 1100	1
C11	CAP FX VAL.DP MICA 200PF 5% 0 TO +70PPM/C 300V	CM05FD201J03	CDE	101 1200	1

WAVETEK PARTS LIST — TITLE: SPK ASSY PRE WAVE LOAD 452-0960 — ASSEMBLY NO: 1208-00-2709 — REV: A — PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C28 C33 C38 C43	CAP MICA FX VAL DIP 820PF 5% 0 TO+70PPM/C 300V	CD15FC821J03	CDE	101 1820	4
C32 C42	CAP.POLYSTY.EPOXY CASE.A/L 0 01UFD 1% 100V	PSBPC1103F	AMRAD	104 3104	2
C24 C31 C34 C41	CAP.POLYCARB. 1UF 1% 100V	C311104F	BIBMD	104 4100	4
C25 C30 C35 C40	CAP.POLYESTER.1 0UF 1% 100V	A311105F	BIBMD	104 5100	4
C29 C34 C39 C44	CAP.VAR MICA. 24-200PF 175V	ST0425	ARCO	108 1200	4
C13 C16 C4 C6	CAP.TANT. 1 0UF 20% 35V	T368A105M035AS	KEMET	109 5100	4
R14	RES.MFLM 154 OHM 1% 1/8W TO	RN55C1540F	UMCEM	110 1540	1
R15 R25	RES.MFLM 1 00K 1% 1/10W T2	RN55C1001F	UMCEM	111 1001	2
R12	RES.MFLM 1 50K 1% 1/10W T2	3063.1D1R500F	MEPCO	111 1501	1
R41 R45 R65 R69	RES.MFLM 1 99K 1% 1/8W TO	CR12D 100PPM	CTLRE	111 1990	4
R20	RES.MFLM 2 00K 1% 1/10W T2	RN55C2001F	UMCEM	111 2001	1
R18 R26	RES.MFLM 2 49K 1% 1/8W TO	RN55C2491F	UMCEM	111 2490	2
R44 R48 R68 R72	RES.MFLM 3 98K 1% 1/8W TO	CR12D 100PPM	CTLRE	111 3980	4
R10	RES.MFLM 4 32K 1% 1/10W T2	RN55C4321F	UMCEM	111 4321	1
R42 R46 R66 R70	RES.MFLM 7 96K 1% 1/8W TO	CR12D 100PPM	CTLRE	111 7960	4
R43 R47 R67 R71	RES FX MFLM 13 9K 1% 1/8W TO	CR12D 100PPM	CTLRE	112 1390	4

WAVETEK PARTS LIST — TITLE: SPK ASSY. PRE WAVE LOAD 452-0960 — ASSEMBLY NO: 1208-00-2709 — REV: A — PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
R49 R53 R73 R77	RES.MFLM 19 9K 1% 1/8W TO	CR12D 100PPM	CTLRE	112 1990	4
R52 R56 R76 R80	RES.MFLM 39 8K 1% 1/8W TO	CR12D 100PPM	CTLRE	112 3980	4
R7	RES.MFLM 64.9K 1% 1/8W TO	RN55C6492F	ENOX	112 6490	1
R50 R54 R74 R78	RES.MFLM 79 6K 1% 1/8W TO	CR12D 100PPM	CTLRE	112 7960	4
R2 R3	RES.MFLM 100K 1% 1/10W T2	RN55C1003F	UMCEM	113 1001	2
R51 R53 R73 R79	RES.MFLM 199K 1% 1/8W TO	CR12D 100PPM	CTLRE	113 1990	4
R57 R61 R81 R85	RES.MFLM 199K 1% 1/8W TO	CR12D 100PPM	CTLRE	113 1990	4
R24	RES.MFLM 200K 1% 1/10W T2	RN55C2003F	UMCEM	113 2001	1
R60 R64 R84 R88	RES.MFLM 398K 1% 1/8W TO	CR12D 100PPM	CTLRE	113 3980	4
R58 R62 R82 R86	RES.VAL CERMET 796K 1% 100PPM/C RN60 SIZE	HA60-796A-1%-100PPM	HYMEQ	113 7960	4
R1	RES.MFLM 900K 1% 1/10W T2	CR25D	CTLRE	113 9009	1

WAVETEK PARTS LIST — TITLE: SPK ASSY PRE WAVE LOAD 452-0960 — ASSEMBLY NO: 1208-00-2709 — REV: A — PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
R59 R63 R83 R87	RES.MFLM 1 39M 1% 1/8W TO	HA60 100PP	HYMEQ	114 1990	4
R22	RES.CFLM 47 OHM 5% 1/4W	CF 1/4 47 OHM 5%	STKPL	116 0471	1
R13 R17 R9	RES.CFLM 100 OHM 5% 1/4W	CF 1/4 100 OHM 5%	STKPL	116 1101	3
R4	RES.CFLM 2 7K OHM 5% 1/4W	CF 1/4 2 7K OHM 5%	STKPL	116 2271	1
R5 R6	RES.CFLM 10K OHM 5% 1/4W	CF 1/4 10K OHM 5%	STKPL	116 3101	2
R11 R19	RES. VAR CMT 50 OHM 3/8SQ FM	72PR50	BECK	118 0500	2
R16 R21	RES. VAR CMT 10K 3/8SQ FM	72PR10K	BECK	118 2103	2
R8	RES VAR CMT 50K 3/8SQ EMVY 20T	67YR50K	BECK	118 3502	1
R23	RES. VAR CMT 200K 3/8SQ EMVY 20T	67YR200K	BECK	118 4203	1
NONE	ASSY PC BD PREPPED 452-0960	452-2710	WVTK	1208-00 2710	1
CR1 CR4	SL IR 6 8V 5% 400MW (1N754A)	1N754A	MOT	131 9680	2

WAVETEK PARTS LIST — TITLE: SPK ASSY. PRE WAVE LOAD 452-0960 — ASSEMBLY NO: 1208-00-2709 — REV: A — PAGE 4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
CR2 CR3	SL LW LR 70P1V 200MW (1N457)	1N457A	FAIR	132 0457	2
NONE	SOCKET I C TO-5	8059-207	AUGAT	353 0801	3
68	COMM TERM PIN .025 SQ (2END)	M239-025-3000	A/B	354 0007	6
71	SPCR NY 1/4D X 3/16L/ 1711D	136P038	MICRO	376 2103	10
72	SPCR NY 1/8D X 1/4L/ 0631D	901801301	MICRO	376 2106	16

WAVETEK PARTS LIST — TITLE: SPK ASSY. PRE WAVE LOAD 452-0960 — ASSEMBLY NO: 1208-00-2709 — REV: A — PAGE 5

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES — MATERIAL — FINISH WAVETEK PROCESS — DRAWN — CHECKED — PROJ. ENGR. — RELEASE APPROV. — UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS ±1/64 DECIMALS .XX ±.01 .XXX ±.005 ANGLES ±1° — DO NOT SCALE DRAWING

WAVETEK

TITLE: PARTS LIST MAINBOARD

SIZE D — FSCM NO 23338 — DWG NO 004 0960 — REV A — SCALE — MODEL 432 — SHEET 1 OF 1

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REV	ECO	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	FRONT PANEL 452	001 0950		001 0950	1
NONE	PANEL ASSY REAR			002 0985	1
NONE	MAINBOARD ASSY 452			004 0960	2
NONE	SUPER KIT	2500-0452-03	WVTK	2500-0452-03	1
NONE	TY-WRAP	TY-523M	TB	2800-00-0006	3
NONE	SIDE FRAME	MP40375	BUKEY	303 0500	2
NONE	TRIM FRONT SHORT	MP40282-1	BUKEY	303 0901	2
NONE	TRIM REAR	MP40281-1	BUKEY	303 0902	2
NONE	SUPPORT BAR MAINBDS (452/852)			303 0908	2
NONE	TRIM FRONT TOP SUPR/BMJB 512	MP40318-4	BUKEY	307 0914	2
NONE	PC SHIELD (452/852)			320 0970	1
NONE	S TOG SPDT ON-ON R8	7101-SYZG	C&K	340 1201	1
NONE	SOCKET CRIMP FEMALE 0931D	42827-2	AMP	353 0106	6
NONE	LUG SOLDER ANGLED #6	1416-6	SMITH	359 0006	1
NONE	LUG SOLDER FLAT 1/4 IN	762-264	ZIER	359 0008	1

WAVETEK PARTS LIST | TITLE: SUBASSY 452 ANALOG FILTER | ASSEMBLY NO. 002 0950 | REV E | PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	CLIP COMP MTG .375 X 1.125	6001-12A	AUGAT	362 2001	1
NONE	CLIP COMP MTG .475 X 1.125	6003-8A	AUGAT	362 2002	1
NONE	KNOB DIAL-BAR 0-10 LTGRY/WHT	03-370 0775	WVTK	370 0775	6
NONE	KNOB MULT 1-10K LT-GRY/WHT-MK	03-370 0776	WVTK	370 0776	2
NONE	KNOB PUSH BUTTON GRAY (452/852)	8303	CRL	370 0778	6
NONE	TIE CABLE NY NAT (CLAMP)	PLC1M-S4-M	PANDT	377 4002	4
NONE	WIRE 624 AWG BON BLACK	1524	WEICO	378 1705	3
NONE	SLVNG PLASTIC FBRGLS #14AWG	PIF130-14	WEICO	378 5141	1
NONE	SLVNG PLASTIC FBRGLS #18AWG	PIF130-18	ALPHA	378 5181	4
NONE	M SCR ST ZN 4-40 X 3/8 PH	2800-23-4106	WVTK	381 4062	8
NONE	M SCR ST ZN PHIL 6-32X1/4			381 6042	18

WAVETEK PARTS LIST | TITLE: SUBASSY 452 ANALOG FILTER | ASSEMBLY NO. 002 0950 | REV E | PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	M SCR ST ZN PH 6-32X3/4 BH			383 6121	4
NONE	NUT HX ST ZN 6-32X1/4 AF			387 6080	4
NONE	WASHER FLAT STL #6 .147ID .312OD .028THK			388 0060	4
NONE	WASHER EXT LK ETL ZN #6			388 1061	2
NONE	WASHER PLT NAS 1/4ID .312OD SHOULDER WASHER	SWSS-2501	MICRO	388 4251	8
NONE	SPR AL 1930C #6 3/8 L	407	KEYST	389 2011	4
NONE	RIVET STL NI .123DX .156L PH			389 8001	2
NONE	SPADE BOLT 6-32 X 7/8 3/8THD	1259	KEYST	389 9001	2

WAVETEK PARTS LIST | TITLE: SUBASSY 452 ANALOG FILTER | ASSEMBLY NO. 002 0950 | REV E | PAGE 3

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED		TITLE: PARTS LIST SUBASSEMBLY
	PROJ MGR		
FINISH: WAVETEK PROCESS	RELEASE APPROV		
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX .XXX		SIZE D | FSCM NO 23338 | DWG NO 002.0950 | REV E; SCALE | MODEL 452 | SHEET 1 OF 1

LTR	ECO NO	CHANGED BY	APPVD BY	DATE
A	RELEASE			2-1-77
B	ECO 245	Joe Lewis		4-24-78
C				
D	1143	LSK SAM		
E	1165	TC 11-18-80		
F	1903	GD 1-21-85		
G	1943	GD 1-22-85		

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION

11.8 dB

1.2 dB

7 dB

+15 VDC

-15 VDC

CUTOFF FREQUENCY

S2 1st DIGIT (SHOWN IN POSITION 1)

S3 2nd DIGIT (SHOWN IN POSITION 2)

S4 3rd DIGIT (SHOWN IN POSITION 3)

S8

X10K
X1K
X100
X10
X1

S5

S6

S9

HI PASS/LO PASS SHOWN IN LOW PASS

FLAT AMPL/FLAT DELAY SHOWN IN FLAT AMPL

SEE NOTE 6

SEE NOTE 6

NOTE 5

NOTE 5

NOTES

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, ±1%
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITORS ARE MFD.
3. * LETTERS A' THRU D', A THRU D REFER TO OPTION 01 CONNECTIONS
4. HIGHEST REFERENCE DESIGNATIONS AR3, C44, CR4, RBB, S9
5. C17 AND C18 ARE REQUIRED FOR 01 OPTION ONLY
6. ASTERISKS INDICATES FACTORY SELECTED VALUE. TYP VALUE SHOWN. (**)

DRAWN BY		DATE 1-1-77
DESIGNED BY		
ENGR APPVL		
MFG APPVL		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE .XXX ±, .XX ±, FRACTIONS ±, ANGLES ±

WAVETEK

TITLE: SCHEMATIC DIAGRAM, MAINBOARD ASSEMBLY (451)

SIZE D | DRAWING NO 03-004.0960 | REV G

SCALE | SHEET 1 OF 1

03-320.0960 REV D